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TRANSFORMATIONAL SENTENCE-COMBINING, A METHOD FOR ENHANCING THE DEVELOPMENT OF SYNTACTIC FLUENCY IN ENGLISH COMPOSITION. FINAL REPORT.

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THIS STUDY REPORTS AN EXPERIMENT ON THE HYPOTHESIS THAT GRAMMAR-RELATED SENTENCE-COMBINING PRACTICE WILL MEANINGFULLY ENHANCE THE NORMAL GROWTH OF SYNTACTIC FLUENCY. TRADITIONAL STUDIES ON ERROR THERAPY AND SENTENCE STRUCTURE ARE REVIEWED, AND DESIGN AND RATIONALE ARE INFERRED FROM THE RESEARCH OF BATEMAN AND ZIDONIS. RULE LEARNING, PATTERN PRACTICE, MODELED WRITING, AND TRADITIONAL PARSING--ALL METHODS FOR ENHANCING GROWTH OF SYNTACTIC FLUENCY--ARE EXAMINED AND REJECTED. INSTEAD, STUDENTS ARE PRESENTED WITH SETS OF KERNEL-LIKE STATEMENTS WHICH ARE COLLAPSED INTO COMPLEX SENTENCES SO THAT THE STUDENTS EXPERIENCE PSEUDO-PRODUCTION INTENSIVELY. PRE-POST WRITING TESTS WERE GIVEN TO 247 SEVENTH-GRADE STUDENTS ASSIGNED TO THREE GROUPS--TRANSFORMATIONAL SENTENCE-COMBINING, CONVENTIONAL PARSING, AND NO GRAMMAR. THE WRITING WAS SEGMENTED INTO T-UNITS AND ANALYZED ACCORDING TO 12 FACTORS OF SYNTACTIC FLUENCY PERTAINING TO NOMINAL AND RELATIVE EMBEDDINGS, FREQUENCY AND DEPTH OF EMBEDDINGS, AND CLUSTERED MODIFICATION. RESULTS INDICATE THAT THE EXPERIMENTAL SUBJECTS EXPERIENCED MORE THAN ONE ADDITIONAL YEAR EXPECTED OF THEM, AND THAT THEIR PROGRESS WAS CONSIDERABLY GREATER THAN THE CONTROL AND PLACEBO GROUPS. TENTATIVE CURRICULAR IMPLICATIONS AND REQUIREMENTS FOR SUBSEQUENT LONGER-TERM RESEARCH ARE DISCUSSED. (AUTHOR)

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Report Number 1

TRANSFORMATIONAL SENTENCE-COMBINING

A METHOD FOR ENHANCING THE DEVELOPMENT OF SYNTACTIC FLUENCY IN ENGLISH COMPOSITION

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Laboratory for Research in Instruction

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1967

FINAL REPORT
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John Mellon

TABLE OF CONTENTS

Page

LIST OF TABLES v

ABSTRACT vii

GENERAL INTRODUCTION 1

CHAPTER ONE: BACKGROUND RESEARCH ON GRAMMAR AND WRITING 4
  Grammar Study in the Schools 4
  Error-Oriented Research Studies 7
  Research on Sentence Structure 10
  The Bateman-Zidonis Study 15
  Summary 21

CHAPTER TWO: ASSUMPTIONS AND HYPOTHESIS 22
  Enhancing the Growth of Syntactic Fluency 22
  Developmental Research on Normal Growth 24
  Existing Proposals for Grammar Practice 30
  Transformational Sentence-Combining 32
  Principal Curricular Assumptions 38
  Procedural Assumptions 40
  Hypothesis and General Plan 42

CHAPTER THREE: DESIGN OF THE EXPERIMENT 46
  Experiment Population 46
  Independent Variables 52
  The Treatments 54
  Procedure 60
  Dependent Variables 67

CHAPTER FOUR: RESULTS AND DISCUSSION 74
  Pre-Post Growth Measurement 74
  Experimental-Control Comparison 78
  Placebo Comparison 89
  Secondary Observations and Findings 94
  Conclusions and Implications 107

APPENDIX A: PRECIS OF THE STUDENTS' GRAMMAR TEXT 115

APPENDIX B: SAMPLE SENTENCE-COMBINING PROBLEMS 126

APPENDIX C: PRE-POST COMPOSITION TOPICS 133

APPENDIX D: GAINS SCORES FOR ALL SUBJECTS 144

REFERENCES 156

LIST OF TABLES

Table | Page
1. Frequencies of Constructions per 100 T-units 28
2. Ability Levels Represented in the Experiment Population . . . 48
3. Comparisons of Mean STEP, IQ, and Reading Scores Between the Classes at Each Ability Level 50
4. Experiment Population and Sub-Groupings 51
5. Academic Degrees and Prior Experience of Participating Teachers 55
6. Practice Sentences Comprising the Experimental Treatment . . 60
7. Assignment of Pre-Post Topic Forms 63
8. Inventory of All T-Units and Words in the Writing Sample . . 66
9. Analysis of Mean Pre-Post Change Scores within the Experimental and Control Groups on the Twelve Factors of Syntactic Fluency 75
10. Comparisons of Post-Test Totals and Group Gains Scores with Hunt's Parameters of Normal Growth 77
11. Comparison of Post-Test Mean Scores of the Experimental and Control Groups on the Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried 80
12. Comparison of Post-Test Mean Scores of the Experimental and Control Groups on Eight Additional Factors of Syntactic Fluency, with Pre-Test Scores Covaried 84
13. Comparison of Post-Test Mean Scores of the Experimental and Control Sub-Groups and the Placebo Group on the Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried . 90
14. Pair Comparisons of Mean Gains Scores of the Experimental and Control Sub-Groups and the Placebo Group on Nine Factors of Syntactic Fluency 92

Table Page

15. Comparison of Post-Test Mean Scores of Boys and Girls in the Experimental and Control Groups on the Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried 96

16. Mean Gains-Score Interactions of Treatment with Low-High Pre-Test Stratification on the Twelve Factors of Syntactic Fluency 97

17. Comparison of Pre-Test Scores of all Subjects on the Twelve Factors of Syntactic Fluency as Indices of Developmental Levels of Urban, Suburban, and Private School Students 100

18. Comparison of Mean Post-Test Scores of Urban and Suburban Students in the Experimental Group only on The Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried 101

ABSTRACT

This study reports an experiment on the hypothesis that grammar-related sentence-combining practice will meaningfully enhance the normal growth of syntactic fluency, that is, the typical rate at which the sentence structure of student writing becomes more elaborated and diversified. Traditional studies on error therapy and sentence structure are reviewed, and the conclusion is advanced that preoccupation with the former has reduced the effectiveness of treatments on the latter. Central issues of design and rationale are inferred from the research of Bateman and Zidonis.

The principal assumption underlying the hypothesis is that normal growth of syntactic fluency may be enhanced by special treatment artificially enriching the student's language experience. Parameters of annual growth during the junior high school years are drawn from developmental research, particularly that of Hunt. As methods for enhancing growth of syntactic fluency, the following are examined and rejected: rule learning, pattern practice, modeled writing, and traditional parsing. A novel alternative method is advanced which presents students with sets of kernel-like statements which are then collapsed into single, fully-formed complex sentences in such a way that the student experiences the pseudo-production of these sentences in a specially intensive manner. This practice, named transformational sentence-combining, was given as a problem-solving activity comprising one part of the student's work in linguistics. Its effects were measured in samples of approximately 90

T-units of uncoached student writing.

The sample used in the experiment consisted of 247 seventh-grade students assigned to three treatment groups--transformational sentence-combining, conventional parsing, and no grammar. Subjects were equally divided between boys and girls, and represented five general ability levels drawn from urban, suburban, and private schools. Inter-group equivalences were observed at all levels on the STEP Writing Test as well as on tests of intelligence and reading. Pre-post writing was in response to nine pairs of parallel topics, with subjects receiving one half of each pair in the fall of grade seven and the other half in the spring. Writing was segmented into T-units and analysed according to twelve factors of syntactic fluency pertaining mainly to nominal and relative embeddings, frequency and depth of embedding, and clustered modification.

Results are presented which indicate that the experimental subjects experienced more than the one additional year of extra growth hypothesized for them, and that their post-test syntactic fluency was significantly greater than that of the control (conventional grammar) subjects. A placebo comparison relating the no-grammar groups to the other groups favored the experimental group and found the control and placebo groups mutually indistinguishable. Further analysis indicated that the treatment was as effective for boys as for girls and for urban students as for suburbans. A sub-sample check of overall quality showed no undesirable effects stemming from the sentence-combining practice. Tentative curricular implications and requirements for subsequent longer-term research are discussed.

GENERAL INTRODUCTION

This study is addressed to that large community of teachers and educational service personnel whose main professional activities fall within the province of the school English curriculum. Its purpose is to report the findings of an experiment measuring the effects of a novel kind of sentence-combining practice as observed in the writing of approximately 250 seventh grade students over a period of one academic year, and to comment on the implications of these findings for future curriculum development work in English. The practice treatment under investigation was presented to students in the form of problems to be solved in connection with their study of an elementary course in transformational grammar. Thus the present experiment stands squarely in the tradition of prior research on the relation between grammar study and improvement of written composition.

Three important features of this study, however, distinguish it in a general way from earlier research. First, this study assumed that the writing-related utility of grammar may be other than the editorial or "corrective" function so often investigated in the past. Second, it in no way hypothesized that the learning of grammatical formulations *per se* automatically leads to improvement of writing, or that such memorized principles can be "applied" in any conscious manner. Third, the study was not undertaken to rule on the question whether grammar should or should not be taught in the schools, since in the writer's belief, this question must be argued on grounds considerably more general than those of a narrowly immediate and often only fancied pragmatism.

This experiment begins with the observation that the sentence structure of ordinary pupil writing becomes increasingly diversified as the student matures. This diversification is customarily looked upon as growth. The question asked was whether such growth could be enhanced by sentence-combining practice occasioning the pseudo-production of sentences more mature in structure than those characteristic of the student's current writing. The main control group treatment consisted of an equivalent amount of practice in conventional sentence parsing as required in the curriculums of participating schools. Dependent variables were certain indices of sentence structure based on grammatical descriptions of free and uncoached student writing.

Notice in particular that the sentence-combining practice was not in any way represented as instruction in composition. It did not entail the learning of principles subsequently to be employed by the student while writing, nor was it designed to condition him to favor unnaturally complex styles of expression. Moreover, all students in the experiment, regardless of the grammar treatment to which they were assigned, also studied the full composition program of the school they attended. This arrangement reflected the assumption that both linguistics and composition may be accommodated as separately valuable subjects in school English curriculums, and that neither should be regarded as an enabling agent or substitute for the other. The main purpose of this experiment was thus to determine whether specially structured but a-rhetorical activities germane only to the study of grammar may yield fortuitous and quite naturalistic by-products observable in student performances in the composition class.

CHAPTER ONE

BACKGROUND RESEARCH ON GRAMMAR AND WRITING

Grammar Study in the Schools

The study of English grammar has always been a part of the American public school curriculum. General literacy among the electorate was considered essential for the perpetuation of democracy, and grammar study became a means to the former end. Further, in geographically isolated frontier schools and later in urban classrooms populated largely by immigrant children, grammar was viewed as an agent of culture preservation, insuring the survival and predominance of the linguistic mores of New England. Despite these pragmatic reasons for its study, many educators also saw in grammar a kind of inherent validity, since it purportedly trained the mind and reflected, no matter how dimly, an ancient tradition of philosophical inquiry worth studying in itself.

Nonetheless, grammar instruction was justified largely on utilitarian grounds. Three popular intra-curricular claims for grammar were that it prepared one to study a second language, that it aided in the understanding of literature, and that it provided a terminology indispensable for the study of rhetoric. But the two primary purposes of grammar were the following. First, it taught the principles of correctness, or error avoidance, in language usage. Second, it presented for inspection and emulation what was presumed to be the full range of sentence structure available to one in the production of mature language.

The content of grammar study was determined in light of these primary purposes. On the one hand it contained a set of usage prescriptions governing matters of orthography, permitted locutions, and grammaticality. On the other it contained syntax, a set of nomenclature and definitions given together with directions for parsing sentences. Students were expected to memorize both the usage prescriptions and the syntactic terms and definitions. Practice activities in usage typically consisted of correcting error-laden sentences and citing the rules involved. Practice in syntax consisted of parsing example sentences, either labeling the parts as to form and function or displaying them in diagrams. (See, for example, popular school texts by Murray, 1802; Kirkham, 1832; Greene, 1868; Reed and Kellogg, 1877; and Kittredge and Farley, 1913.)

It was not until the first two decades of the present century that real attempts were made to assess the effectiveness of grammar. These seem to have been motivated by predilections against the subject in general, and thus out of a desire to generate empirically-based arguments for dropping it from the curriculum. For grammar had already earned its reputation as the most uninteresting and matter-of-fact subject in the entire school program. Less able children, whose counterparts a century earlier did not even attend school, had proved unable to learn grammar readily or at all, with the result that its study had been extended to nearly all grade levels, where it was visited upon the bright as well as the not so bright in a deadeningly repetitive manner. Further, the unchanging usage prescriptions resembled less and less the lively new vernacular styles, and error-oriented drillwork, aversive under any circumstances, must have seemed that much more pointless and punitive.

One's sympathies lie with opponents of such an approach to linguistic studies, whether then or now. But experiments on these activities are hardly necessary in arguing their inappropriateness.

The actual research of this period seems rather naive by present standards. Briggs (1913), for example, reported that a three-month study of grammar did not improve ability to reason logically or to formulate definitions, and interpreted these findings as a disconfirmation of the claim that grammar disciplines the mind. Hoyt (1906), Boraas (1917), and Asker (1923) found low correlations, none above .40, between scores on tests of grammar knowledge and a variety of scores and grades associated with usage tests, poetry interpretation tasks, composition writing in general, English as a school subject, and subjects other than English. What these one-time correlations mean, in light of the many uncontrolled variables operative in all but the usage tests, the experimenters do not discuss. But they conclude unanimously that grammar is thus a waste of time and should not be studied.

Despite these early efforts, the two principal claims for grammar study were nonetheless subject to meaningful investigation, just as they are today. A paradigm design would compare the effectiveness of a specified grammar treatment with that of some alternate but equally well-defined activity. In testing the editorial claim for grammar, one's dependent variable might be scores on an objective test of ability to recognize and correct certain errors. Or it might be an accounting of errors found in the student's own writing. In testing the claim that grammar study promotes the use of wide-ranging sentence structure, however, one's only recourse is to frequency counts of constructions observed in actual student prose. No matter what behaviors they require of him, "objective tests" which confront the student with language other than his own obviously cannot measure the sentence structure he himself normally employs. Perhaps because studies of the latter sort are extremely time-consuming, few have been conducted. Most existing research on grammar thus pertains to its corrective utility only.

Error-Oriented Research Studies

Of the studies investigating the proposition that learning usage rules is the most effective means for achieving correctness in written expression, many were conducted during the 1930's at the height of the "functional grammar" movement. In effect, the functional grammarians argued that grammar had but a single purpose, and that the nature of this purpose was corrective. The logical thing to do was to limit the content of grammar instruction to usage prescriptions alone, and just those covering errors most frequently found in student writing. Proponents of this approach, whose number includes many present-day English teachers, thus claimed to have found an indefeasible argument supporting their particularly narrow view of the utility of grammar study.

But the research of the period proved them wrong. Experiments by Symonds (1931), Catherwood (1932), Cutwright (1934), and Crawford and Royer (1935) clearly indicate that overt rule-learning is less successful in changing language behavior than are repetitive oral drills alternating between "right" and "wrong" forms in actual sentences. Later studies by

Evans (1939), Milligan (1939), Frogner (1939), and Butterfield (1945) further suggest that when particular errors must be talked about as such, rather than merely drilled over in right-wrong practice, it is better to do so in a "direct method" or "incidental method" or through a "thought approach" rather than by means of usage prescriptions couched in grammatical terminology. Finally, studies by Werner and Guiler (1933) and Karp (1942) indicate that individualized instruction on errors actually committed by students, as compared to mass instruction on lists of common errors, is at least as effective and far less costly in class time. In general, errors are best dealt with in private conversations between student and teacher, and by direct explanation and brief oral drills that do not involve grammatical rules or terminology.

Despite these findings, most subsequent experiments have continued to concern, if not strictly the editorial utility of grammar, at least just those aspects of verbal ability measurable on objective tests. In a factor analytic study which defined composition ability in terms of scores on 23 such tests plus quality ratings of a single composition, Weinfeld (1957) found no significant differences between gains scores of students who had studied structural linguistics and others who had studied conventional grammar. Schuster (1961) and Suggs (1961) also compared the effectiveness of these approaches by observing pre-post gains scores on two objective tests. Schuster found no significant differences between the scores of his two groups. Suggs reports significantly greater gains for her structural grammar class, but implies that the novelty of the treatment may have inflated its effect. Given the fact that methods based on conventional grammar had repeatedly been proved inferior to direct approaches, however, the above studies surely ought to have included a direct-method treatment in addition to the ones employed. Weinfeld did include such a treatment, which he termed a "verbal fluency" method. Although its effects, like those of his structural method, did not differ significantly from those of the conventional approach with which it was compared, Weinfeld notes that the direct verbal-fluency method nevertheless seemed superior to the structural one.

Studies by Harris (1962) and by Bateman and Zidonis (1964) compare the prevalence of error in actual compositions written by two groups of students before and after a two-year study of grammar and no-grammar, respectively. Harris compared a direct-method approach with one based on traditional grammar, whereas Bateman and Zidonis employed a transformational-generative grammar. Of fourteen common errors, Harris found that in the grammar group thirteen occurred one or more times in more post-test compositions than pre-test ones. In the direct-method group, six were more frequent at post-test than at pretest, while six were less frequent. In addition, Harris found significant differences favoring the direct-method classes in number of words per common error and in number of correct minus incorrect sentences, but no differences in omissions of end punctuation. Bateman and Zidonis computed ratios of error-free sentences to total sentences, and found that the gains of the grammar class were significantly greater than those of the no-grammar class. They also sorted all observed errors into five categories, totaled the frequencies in each, and computed five sets of pre-post error reduction scores. Here again the results generally favored the grammar class over the no-grammar class. Thus while the work of Harris merely confirms the results of earlier research favoring direct methods over approaches based on traditional grammar, Bateman and Zidonis' findings apparently indicate that the study of transformational grammar does reduce error. In the latter study, however, the treatment received by the no-grammar group is completely unspecified, and the comparative data cited above are therefore quite meaningless.

Research on Sentence Structure

Turning from error-oriented research, one finds it difficult to uncover even a single experiment on the claim that studying traditional grammar leads to the use of a wider range of sentence types. Since diagramming practice was a means for illustrating sentence structure, its effectiveness might have been appraised in terms of the above claim. But Barghahn (1940) reports only that diagramming has no effect on usage skills as measured by objective tests of capitalization, punctuation, and error recognition. Stewart (1942) shows that it does not influence reading comprehension, and Tovatt (1952) finds that the ability to diagram is likely to be forgotten beyond the school years. Diagramming was never intended to influence correctness, however, and the other evidence is plainly irrelevant, not only to the sentence-structure claim but to all aspects of the grammar and writing question.

Two major studies already cited report construction counts based on actual student writing, and thus have the appearance of testing the hypothesis that grammar extends the range of available sentence types. Milligan (1939) counted the complex sentences, simple sentences, and dependent clauses occurring in five pre-test and five post-test compositions written by his grammar-method and incidental-method groups. The results of these counts seem ambiguous. As between simple and complex sentences, Milligan's grammar classes produced a higher proportion of the former than did his incidental-method classes. On the other hand, the grammar classes wrote more dependent clauses than did the other group. In any case, Milligan advances no hypothesis as to the growth of sentence structure. In describing the two experimental treatments, he reports only that the grammar classes studied "items of grammar . . . which, if applied, make for sound sentence structure" (p. 91), and that the incidental-method classes wrote extra inter-test compositions and studied content based from day to day on "needs revealed in the compositions" (p. 91). One cannot tell what kinds of practice sentences were actually examined by the two groups. Since both treatments were error-oriented in approach, and since one included more inter-test practice on the dependent variable of the study than did the other, it is a real question whether the construction counts would have meant anything at all even if they had clearly favored one group of students over the other.

In the study by Harris (1962), 500-word before and after compositions were secured from students in both the grammar and the direct-method classes. Harris analysed this writing according to eleven "criteria of maturing style," seven of which were represented by frequency counts of words per simple and complex sentence, non-simple minus simple sentences, subordinate clauses, complex sentences, different sentence patterns, adjectival phrases and clauses, and qualifying phrases in simple sentences. Such an analysis obviously constitutes an implicit test of the sentence-structure hypothesis, although a single composition per student is an inadequate basis on which to conduct such a test. Since five pairs of classes comprised the two groups of students, 35 differences were possible on the above seven criteria. Six of these were significant, and all favored direct-method classes. Four of these differences were in the number of complex sentences, and two were in the number of different sentence patterns. Apparently more concerned for the error-oriented aspect of his research than for what the above findings seem to reveal about growth of sentence structure, Harris concluded that the study of English grammatical terminology had a negligible effect upon the correctness of children's writing. In short, Harris like Milligan phrases both his hypothesis and his conclusions in terms of "correctness," or error avoidance, in writing.

Notice that Harris' no-grammar students, like Milligan's incidental-method ones, were given extra inter-test writing practice and reportedly learned to discuss their errors in an easy, uninhibited manner. The grammar students, on the other hand, drilled extensively on grammar rules and nomenclature, and were allowed to speak about their composition errors only in these terms. Furthermore, scores on tests of grammatical knowledge revealed that this group had learned its lessons poorly indeed. In view of these facts, a re-examination of the construction-count data reported by Harris and Milligan raises an interesting question with respect to error-centeredness and growth of sentence structure. While the grammar classes wrote fewer complex sentences than did the no-grammar classes, they wrote either more dependent clauses (Milligan) or exactly as many (Harris) as did the no-grammar groups. In both cases this means that the complex sentences the grammar classes did produce contained many more clauses per sentence than did those of the no-grammar classes, a fact which could be attributed to their having examined a great many such sentences in their grammar practice. Their refusal to write very _many_ of these complex sentences could in turn stem from the fact that students naturally opt for the "safest" and thus the simplest of sentences in situations where being caught in an error means that they must then discuss it in a confusing and punishing manner. What the Milligan and Harris studies prove, it thus seems, is not that grammar does or does not promote growth of sentence structure, but rather that such growth may be retarded or otherwise constrained by error-oriented pedagogy.

Despite the absence of research specifically directed to the sentence-structure claim, the possibility that grammar practice will lead to the use of mature syntax has received considerable attention in recent years in the form of proposals for teaching methods advanced by proponents of structural and transformational grammars. Journal articles advertising these newer grammars have popularized notions such as "sentence pattern," "modeled writing," "expansions," "embeddings," and the like. Mallis (1957) and Bertsch (1962), for example, propose that students write sentences conforming to patterned strings of grammatical terminology. Senatore (1957) and Tyler (1962) suggest that writing might be modeled on actual or nonsense-word passages of varying structure. Wolfe (1964) advocates the use of example sentences taken from literature and given together with directions couched in grammatical terminology in order to practice students in the production of similar sentences. Ianni (1964) and Newsome (1964) argue that the same thing can be accomplished more effectively within the framework of transformational grammar rather than in the traditional setting suggested by Wolfe. These proposals represent a departure from the strictly corrective notions of the functional grammarian, in that they view grammar as enabling a kind of language practice which in turn will cause the student to employ more mature sentence structure

A case study by Bateman (1959) illustrates one way in which the effectiveness of such practice might be investigated. Daily throughout a one-year unit on structural grammar, Bateman required students to analyse a sentence chosen from contemporary literature, then to write one or two sentences of their own conforming to the observed pattern. Bateman counted several types of "modifications" together with their "layer" number in before and after compositions, then reported totals on a single student who had made significant gains indeed. It would seem from the specimen compositions, however, that Bateman coached his students in their writing and made imitation of style the actual end of their labors. Stylistic imitation, or modeled writing, doubtless has its uses, although some students are likely to feel intimidated in the presence of literary or professional prose, and all would find the activity demeaning were it to become the sole approach to composition. But despite this apparent concern for conscious imitation during the writing act, Bateman's work makes two important contributions to the problem of understanding the relationship between grammar study and development of sentence structure. The first is the general notion that the language practice facilitated by the grammar, rather than the learning of grammatical formulations themselves, is the factor which assumedly influences maturity of sentence structure. The second is the manner of analysing student writing in order to observe the effects of such practice. "Modifications" turn out to be roughly the same as embedded sentences, "layer" number is equivalent to depth of embedding, and increases in both of the latter are known to be criterial of maturity in student writing.

The Bateman-Zidonis Study

The recent study by Bateman and Zidonis (1964), in addition to its concern for error, also tests the hypothesis that the study of grammar, in this case transformational-generative grammar, improves the ability to employ mature sentence structure. Of four "specific questions guiding the study" (p. 4), two pertain to error while the other two are as follows:

> Can high school pupils learn to apply the transformational rules of a generative grammar in their writing?
>
> Can their repertoire of grammatical structures be increased by a study of generative grammar? (p. 4)

The Bateman-Zidonis study thus stands as the only experiment in the entire canon of grammar and writing research that explicitly advances a sentence-structure hypothesis. It will be examined rather carefully here, since many of the design features of the present study were decided in light of issues raised by Bateman and Zidonis' generally quite valuable research.

The investigators secured six pre-test and six post-test compositions from students in their grammar and no-grammar classes, tagged the sentences according to whether or not they contained errors, then computed mean "structural complexity scores" for sentences of each type per student per test. The structural complexity of any sentence was 1 plus the number of transformations it contained from a list of 54 such rules compiled by the investigators. The average gains score on error-free sentences for the grammar class was 9.3, compared with 3.8 for the control class. In a two-way treatment-by-test-time analysis of variance, the pre-post differences were significant for all students regardless of grouping, a fact reflecting the occurrence of normal growth in the absence of special treatment. The first-order interaction was also significant, favoring the experimental class at post-test. Thus it would seem that the transformational grammar unequivocally accomplished what was hypothesized for it, namely, it accelerated the normal growth of sentence complexity.

But the experiment presents a number of interesting problems of interpretation. In regard to structural complexity scores, Bateman and Zidonis state that the failure of the experimental-control (regardless of test-time) F ratio to reach significance compromises their significant interaction F. But this demurrer is wholly mistaken, since it penalizes the experimental group for being exactly what it should have been, that is, equal to the control group at pre-test. A better plan for the measurement of change probably would have been a one-way analysis of variance at post-test, using the pre-test measure as a covariate. It also happens, however, that four students in the experimental class had gains scores averaging 34, whereas those of the other 17 students averaged about 4. No such skewness was apparent in the control class. Bartlett's test for homogeneity of group dispersions reveals a significant difference between the post-test variances within the two groups, and indicates that analysis of variance was an inappropriate statistic for the data at hand. To put it simply, all the "extra" gains of the experimental class were made by four students.

Next, Bateman and Zidonis' scheme for computing structural complexity leaves much to be desired. Their use of the orthographic sentence ignores the findings of Hunt (1964), who shows that the independent clause is a more reliable unit. Apparently the experimenters wished to count coordinate conjunction resulting in compound sentences, although the incidence of this structure is inversely proportionate to maturity. In addition, the investigators counted singulary and predicate complement transformations, even though Hunt's study (which is referenced by Bateman and Zidonis) shows that these occur as frequently in the writing of young children as of older ones, and thus are not criterial of maturity. Since there would be a great many of these transformations present in the writing of both groups, and since their relative frequencies would not be expected to differ from pre-test to post-test, counting them would have the effect of reducing the mean differences observed between groups on transformations which do increase with age and are thus amenable to treatment. The investigators should have confined their attention, as Bateman (1959) did in his earlier case study, to embedding transformations only, as well as to factors such as depth of embedding and number of modifications per noun.

Furthermore, there is a perplexing lack of fit between reported complexity scores and the data given on amount of writing produced. Subject number 18, for example, who had the highest gains in the experimental class, wrote 51 sentences in 1107 running words at post-test, for a mean sentence length of about 22 words. Forty-nine of these sentences are listed as well formed and containing 382 transformations. By the method outlined on pages 16 and 17 of the study, these totals would yield a mean structural complexity score of 382 plus 49 divided by 49, or just under 9. But the average reported is 70. This in turn suggests that the student's 49 sentences actually contained over 2700 transformations, and that his 22-word sentences averaged about 55 transformations each -- a prodigious total indeed. Apparently the investigators have not given their analytical procedures as full a write-up as one might wish.

Certain other methodological problems also arise. The investigators note that their subjects, who attended a university laboratory school, were not representative of public school students generally. They do not describe the mode of discourse of the writing sampled, nor do they characterize the conditions under which it was assigned. Furthermore, as pointed out earlier, they make no attempt whatever to describe the control-class treatment. One finds only the following:

> Each class studied what would be considered the regular curriculum at the school with this exception: the experimental class studied materials specially adapted by the investigators from the area of generative grammar. (p. 10)
>
> In each class, improvement of pupil writing was one of the major objectives. The classes differed only in content: no formal grammar was studied in the control class; the grammatical content described in Chapters 2 and 3 was studied by the pupils in the experimental class. (p. 117)

Reading this, it is impossible to learn what the control class did do, and thus what the experimental treatment was compared with. Surely this is a major oversight in such a study.

Then finally, the hypothesis of the entire experiment rests upon a line of argument which is difficult to accept on rational grounds alone. Bateman and Zidonis correctly state that transformational grammars describe "the process of sentence formation" (p. 2). But when they speak of the need for pupils to understand "the way language actually works" (p. 2), and then assert that "generative grammar . . . is in essence a representation of the psychological process of producing sentences" (p. 2), they reify the notion of process and apparently elevate it to the level of consciousness. But this is disconfirmed by the introspective evidence available to anyone who speaks language. In claiming that "pupils must be taught a system that accounts for well-formed sentences before they can be expected to produce more of such sentences themselves" (p. 3), Bateman and Zidonis ignore the fact that children have been producing grammatically complex and for the most part well-formed sentences since their pre-school years. Indeed, the word "more" seems to turn the statement into a self-contradiction. It is also suggested that generative grammar "should provide the most fruitful framework from which to investigate and modify the composing process" (p. 6). But the "process" which grammars describe is speaker-hearer neutral. It differs from that which might be formulated in description of comprehension,and is totally unrelated to the completely open question of how pre-structured intentions to say or produce certain statements arise in the brain.

In general, Bateman and Zidonis seem to be arguing that the learning of grammatical formulations can result in their being consciously "applied" in the production of mature sentence structure. But this is no more than a re-statement in generative terms of the claim originally made for traditional grammar, and it is as implausible now as it was then. In addition, it represents an abandonment of Bateman's earlier insight that it is the language practiced, not the grammatical principles which the practice is intended to exemplify, that may influence subsequent production. Notice that the developmental research cited below shows that all transformations occur in the compositions of even the youngest writers. Maturity of sentence structure is indicated by more frequent use of certain of these, and by the occurrence of more of them in concert within single sentences. But a grammar, which is no more than a roster of rules, says nothing whatever as to the number of transformations likely to occur per sentence. Thus, regardless of the phrasing of the Bateman-Zidonis hypothesis, what actually would have influenced special growth of sentence structure, assuming the students were not coached or conditioned by exercises in the imitation of style, was either the highly elaborated language doubtless used in classroom discussions of the grammar, or else the similarly complex sentences which may have been set forth for illustrative purposes or parsing practice. But the investigators do not report on the practice sentences examined by the students.

Summary

One is thus left with the conclusion that existing grammar and writing research has examined almost exclusively the editorial claim for grammar study, and practically not at all the sentence structure claim. Further, the few studies which feature construction counts based on actual student writing and which thus might be cited as evidence on the latter claim, despite their failure to hypothesize on it, seem to be contaminated by the error-centered teaching methods which they were primarily designed to evaluate. Although proposals have been advanced for grammar-related activities intended to promote the development of mature sentence structure, these either remain uninvestigated or else stress the role of imitation in the writing process to a degree which most composition teachers would regard as excessive. Finally, the one study which explicitly tests a sentence-structure claim employs questionable design and analytical procedures, and rests on a hypothesis which seems altogether unreasonable.

CHAPTER TWO

ASSUMPTIONS AND HYPOTHESIS

Enhancing the Growth of Syntactic Fluency

The research discussed above clearly shows that memorized principles of grammar, whether conventional or modern, play a negligible role in helping students achieve "correctness" in their written expression. It further suggests that pervasive emphasis upon the corrective aspects of grammar creates an atmosphere of error-orientation which may inhibit growth of sentence structure and doubtless engenders a wide variety of negative and hostile feelings towards writing in general and linguistic studies in particular. For the moment, then, it would appear that additional experiments on existing notions of error therapy are unwarranted. On the other hand, the above research rather strongly implies the timeliness of experimentation related to the traditional claim that grammar practice results in the use of increasingly mature sentence structure. The present study reports one such experiment.

It has frequently been noted that the range of sentence types in free student writing increases in a continuous and sequential manner as the student matures. These increases have been studied in some detail, and the results of this developmental research are summarized below. In a general way, growth of sentence structure is reflected in a host of commonplace observations on developmental changes in student writing -- that independent clauses grow longer, that sentences become more highly elaborated, that more subordination is used, that a wider range of sentence patterns is employed, or that sentences become on average more heavily and deeply embedded. Growth of sentence structure, however, is not a substantive phenomenon. It is merely evidence that the student, through gaining greater experience in the world around him, has learned to construe and take cognizance of this world and of his relation to it in an increasingly adult manner. It is this cognitive growth that results in his making fuller use of permitted grammatical operations, and that produces the changes in his sentence structure noted above.

Growth of this sort, whether one speaks of cognition or of the sentence structure which manifests it, occurs normally and without the aid of formally designed pedagogy. But normal growth need not be considered optimal growth. It refers merely to what has been observed, and should not be viewed as the maximum permitted by some presumably fixed schedule of "natural" growth. Indeed, the assumption that such growth is variable and thus amenable to treatment is supported by the widespread belief that differences in verbal ability between same-age children result in large part from widely discrepant prior language experiences in differing home and school environments. Thus the initial assumption of this study is that rates of growth towards more mature sentence structure may be enhanced by special treatment.

Maturity of sentence structure is here stipulatively defined, in a strictly statistical sense, in terms of the range of sentence types observed in representative samples of a student's writing. Since this is a rather lengthy and cumbersome phrase, the present study henceforth employs the term "syntactic fluency." The intention of this novel term is somewhat analogous to that of the more familiar "vocabulary fluency," in that both refer to ranges of linguistic types, the former being sentence types and the latter word types. The question to be considered, then, is whether grammar practice may enhance the growth of syntactic fluency.

Developmental Research on Normal Growth

Plans for stimulating the development of syntactic fluency obviously must be based on a knowledge of normal growth, since experimental treatments designed for use at certain grade levels would doubtless present students with sentence types which are known to appear subsequently in their writing, but which are not generally characteristic of it at the time of presentation. Although syntactic fluency probably does not develop in exactly the same way for all children, it is possible to gain a fairly clear picture of mean growth parameters for representative groups of students at different ages.

Many studies of language development are reviewed by McCarthy (1954) and Carroll (1960), who summarize research on both spoken and written language. Early investigations of writing sought only to identify a single index for evaluating general maturity. Mean sentence length, percentage inventories of parts of speech and the major sentence types, and ratios of subordinate to total clauses were the measures most frequently used. Stromzand and O'Shea (1925), Frogner (1933), LaBrant (1933), Bear (1939), and Heider and Heider (1941) all find evidence of continuous growth from year to year on one or more of these measures, although certain methodological errors in these studies have recently been noted by Hunt (1964) and Mellon (1965). But the main difficulty is that any single index of maturity, while it may reflect syntactic fluency, does not characterize it fully enough to be useful in the sense suggested above.

Until recently, research on speech had produced more construction-count data than had writing research, but it is questionable whether findings based on spoken performance are applicable to writing. The work of Davis (1937), Templin (1957), and Loban (1963), for example, is based largely on "remarks" elicited from children during interviews. The high percentage of "functionally complete but structurally incomplete" responses indicates that considerable question-answering behavior was being measured. This presumably differs in structure from what the child might produce in written discourse. Indeed, Harrell (1957) has compared the use of subordinate clauses in oral and written compositions on identical topics. He finds that the number of subordinate clauses increases with age in both, but that these clauses are longer in oral compositions through grade eight, after which they become longer in the written ones. Variability of clause length at all grade levels is greater in writing than in speech. Few adjective clauses occur orally, while a great many are used in writing. One may thus conclude that developmental changes in written sentence structure are unique thereto and cannot be observed in studies of speech.

At the same time, however, one may ask whether research on aural/oral performance indicates that children have acquired full competence repertoires by the time they reach the writing age, probably grade four. The conclusion implied by Watts (1944), and in the studies reviewed by McNeill (1966), is that they have. Furthermore, Hunt (1964) finds that all the kernel-sentence types, including those with predicate complement embeddings, are used as fully and as frequently by fourth graders as by twelfth. The same is true of the simple transformations. Hunt also notes that all transformations which operate on embedded sentences have been acquired by even the youngest writers, although they are used more often by older ones. Treatments for promoting growth on the part of secondary school students may therefore be designed in the knowledge that these children have long since acquired, and that they normally use, the full roster of kernel-sentence types and transformation rules.

It follows, then, that growth of syntactic fluency can result only from increased use of sentence-embedding transformations. The recent work of Hunt (1964 and undated), as subsequently confirmed by O'Donnell, Griffin, and Norris (1967), depicts with reasonable clarity the norms of this growth. Hunt examined 1000 words of free writing per student as produced by groups of fourth, eighth, and twelfth graders, together with an equal number of 1000-word samples taken from non-fiction magazine articles published in Harpers and Atlantic. The latter he terms "skilled adult." Although Hunt devotes considerable energy to showing that T-unit length is a more accurate index of maturity than are subordination ratios or length of orthographic sentence, it is his construction-count data based on complete grammatical analyses of all T-units examined that are of greatest importance to the present study. Curiously enough, however, Hunt reports this data on the basis of running words rather than number of T-units, apparently failing to recognize that his new unit is the base of analysis arithmetically as well as grammatically. In other words, the interesting question is not frequency of certain constructions per so many words, it is their frequencies per so many T-units. This has to be the case if frequency is to mean anything, since the sentence structure of skilled adults is so much more highly differentiated than that of fourth graders, for example, that adults write two and one third fewer T-units per given number of words than do these young children. Comparing absolute construction counts based on samples of equal numbers of words, as Hunt does, thus reduces the apparent magnitude of differences between age levels.

The following discussion, as well as the criteria subsequently employed in this experiment, is therefore based on a re-working of Hunt's data. Since the absolute totals of T-units and of the several construction types are given for each level, the construction totals may be converted by a simple ratio and proportion formula and shown as they would appear if produced in 100 T-units. The resulting figures are directly comparable across age levels, and may be regarded as parameters of normal growth. Hunt's findings show that intra-T-unit coordinate conjunction, comparative conjunction, and adverbial clauses do not fluctuate with age. In the case of adverbials, however, radical decreases in temporal clauses obscure the fact that the concessives, causals, and conditionals do increase somewhat. But in general, it is the nominal and relative transforms whose consistently greater frequencies per T-unit characterize growth of syntactic fluency. Table 1 presents Hunt's findings on these transforms, converted by the method given above and summarized under the six construction categories listed.

Table 1

Frequencies of Constructions Per 100 T-units

Construction type	Grade 4	Grade 8	Grade 12	Adult
Nominal clauses (fact and question)	9	12	27	21
Nominal phrases (gerund and infinitive)	6	10	23	not available
Relative clauses (less time and place)	5	9	16	25
Relative phrases (post-noun modifiers)	13	28	46	92
Relative words (pre-noun modifiers)	33	68	81	152
Unique dominant nominals	9	20	34	not available

The "dominant nominals" mentioned in Table 1 refer to the full nominal constructions in the primary grammatical functions of T-units -- subject, object, and so forth. Notice also that in dominant nominals containing one or more embeddings, the four age levels average the following numbers of these embeddings per nominal:

Grade 4	Grade 8	Grade 12	Adult
1.19	1.39	1.43	2.42

Another way to view the tabled figures is to divide them by 100, in which case they represent the percentage of likelihood that the associated construction will occur in an individual T-unit.

Clearly, Hunt has shown that the hallmark of mature syntactic fluency is the ability to "say more," on average, with every statement. Increased use of relative transforms means in effect that the student more often makes secondary statements, either fully formed or elliptical, about the nouns in his main sentences. Greater use of nominalized sentences means that he more often predicates upon statements, as it were, rather than upon simple nouns. Furthermore, transformed sentences will be recursively embedded at increasingly deeper levels, and relative transforms will be more frequently used in parallel "clusters" surrounding single nouns. Notice that by grade twelve, one out of every three dominant nominals produced by the student will be a unique type, whereas in grade four only one in ten would be. And most striking of all, it would seem, is how far even the oldest students have to go in order to match the performance of skilled adults. Generally speaking, then, the above embedding transforms, together with measures of depth of embedding, cluster size, and unique nominal patterns, constitute the appropriate criteria for describing growth of syntactic fluency. In like manner, example sentences used in the secondary grades as practice exercises designed to enhance this growth would feature many of these transforms in concert, and would exemplify the widest possible diversity of grammatical patterns.

Existing Proposals for Grammar Practice

Several grammar-related activities have already been mentioned which would cause students to experience given sentences in certain specially planned ways, and would thus presumably lead to enhancement of syntactic fluency. Four proposals have been cited -- modeled writing, applied transformation rules, pattern practice, and traditional sentence parsing. Each may be rejected in turn. First, modeled writing differs from the other procedures listed in that it requires only the straightforward imitation of style, and thus is not really contingent in any way on prior grammar study. Furthermore, it results in the production of discourse and presumably therefore entails a response to some rhetorical occasion. In short, modeled writing is actually a disguised form of composition. But as noted, this activity misrepresents to the student the nature of the composing process, and contains no provision for specifying the purpose of the writing it invites. In general, a condition required of schemes for grammar-related language practice is that they be a-rhetorical in nature and not give the appearance of pertaining to the student's work in composition. Certain advantages of this approach are discussed below.

A second proposal for research was that investigated in the Bateman and Zidonis study, namely, that the student learn the transformation rules of a generative grammar so that he can later apply these rules in writing. As pointed out, however, students who have reached the writing age have already acquired complete sets of these rules in their internalized competence. And even if they had not, it would be absurd to believe that memorizing formulations of rules might occasion their acquisition, just as it is idle to pretend that transformations can be consciously applied in the production of sentences. People simply do not behave in these ways. Then too, it has just been shown that maturity of sentence structure does not stem so much from the use of particular rules in isolation as from their more frequent use together in single statements. Thus a second condition on grammar-related practice activities is that they must in some way confront the student with actual sentences of mature structure. It is not enough to present transformation rules alone, nor to exemplify them by means of sentences embodying the given rule but no others.

Pattern practice and traditional sentence parsing, although they are a-rhetorical and may indeed feature mature sentences, are unacceptable for still other reasons. Pattern practice requires the student to write sentences whose structures conform to given strings of grammatical terms. While the final behavior elicited from the student is the production of a pre-described sentence, the weakness of this activity is that it forces him to provide his own content, apropos of no purpose whatever, to be grafted onto the stipulated grammatical framework. But searching for pointless content surely distracts him from the very thing to which he is supposed to be attending, namely, the given pattern. Traditional parsing, on the other hand, begins with actual sentences and requires that their constituents be segmented and labeled. Here the student experiences no part of the production process. And while he does attend initially to the inter-relationships between content and structure in fully-formed statements, his attention subsequently becomes focused within isolated constructions and in the end is directed to the wholly irrelevant problem of selecting correct terminological labels. To be acceptable, then, routines for grammar-related language practice must satisfy two further conditions. One of these is that the final behavior elicited from the student must be the writing of a fully-formed statement whose structure is pre-determined and characteristic of mature expression. The other is that the content of such pseudo-production activities must be provided at the outset, and must be given in a grammatical format which optimally and unobtrusively facilitates the student's realization of this content in the form of the desired statement. Since the above proposals for enhancing syntactic fluency fail to meet the foregoing conditions, they almost certainly do not merit experimental study. Consequently, it was decided that some alternative procedure should be considered in their stead.

Transformational Sentence-Combining

The grammar-related practice activity examined in this study was designed to satisfy the four conditions outlined above. It was presented to the student in the form of sentence-combining problems to be solved in connection with his study of a transformational grammar. In solving these problems, the student experienced the pseudo-production of a range of sentences more mature in structure than those typical of his writing at the time. In general, the aim of these problems was to direct a maximum of the student's attention to the way that content initially expressed in collections of separately represented kernel sentences may be collapsed into single statements. The overt tasks required of the student were first that he transform the separate sentences according to directions keyed to rule formulations he had earlier studied, then that he embed these transforms as constituents in other sentences according to a simple embedding format employed in all problems, and finally that he write out the result in the form of a single fully-developed complex sentence. In short, the student was given a set of kernel sentences plus directions for combining these sentences into a single complex statement, which he was then required to write out.

The following is an example illustrating the form of these transformational sentence-combining problems. A problem such as this would appear in about the seventh month of the grammar course:

<u>Problem</u>:

```
The children clearly must have wondered SOMETHING.
     The bombings had orphaned the children.
     SOMETHING was humanly possible somehow. (T:wh - T:exp)
          Their conquerors pretended SOMETHING. (T:infin)
               Chewing gum and smiles might compensate for the losses.
                                                          (T:fact)
                    The losses were heartbreaking.
                    They had so recently sustained the losses.
```

<u>Write-out</u>:

(Here the student writes the fully-formed sentence.)

____

____

The student would have studied the transformations involved, and he would also have become thoroughly familiar with the details of format, which are purely mechanical and readily learned. Briefly, the right-hand indentations show how the embedding is to proceed. The first sentence is always the main clause. The sentence or sentences immediately beneath it and spaced one place to the right are to be embedded therein, and so on down the list of successively right-spaced sentences. The capitalized word "SOMETHING" indicates an open nominal position, repeated nouns signal relativization, and parenthetical items are abbreviated transformational directions where necessary.

In solving problems such as the above, the student begins with the main-clause sentence incremented by the first embedded transform. Since he is not to write the sentence until it is fully formed, his first step above is simply to relativize the second sentence and to say the following:

> The children whom the bombings had orphaned clearly must have wondered something.

He then nominalizes the third sentence as a question clause, inserts it in place of "SOMETHING," and says the following as a second approximation of the final sentence:

> The children whom the bombings had orphaned clearly must have wondered how something was humanly possible.

This process is continued until all sentences are transformed and embedded. Finally, while holding the fully-formed sentence in memory, the student writesit out as follows:

> The children whom the bombings had orphaned clearly must have wondered how it was humanly possible for their conquerors to pretend that chewing gum and smiles might compensate for the heartbreaking losses which they had so recently sustained.

Additional illustrations of these sentence-combining problems are given in Appendix B. Several further comments may be made at this time. Pre-experiment trials indicated that junior high school students of virtually all ability levels are capable of solving these problems. Bright students, in fact, soon become adept at reading out the final complex sentence after a single run-through of the listed kernels, whereas average and slower students follow the strategy outlined above, rehearsing the sentence after incrementation by each successive embedding until the finished product is achieved. Motivation for these problems arises in part from the student's desire to grapple with increasingly challenging sentences, and in part from his curiosity to know what each completed sentence has to say. Notice that while the kernel sentences taken together embody the total content of the final statement, reading them separately provides only an intriguing suggestion as to how they may be ultimately inter-related. Finally, the student learns to rely, obviously, on his inherent sense of grammaticality to test the correctness of the sentences produced. The automatic perception of grammaticality acts much like a special kind of positive reinforcement noted each time the student rehearses all or any preliminary part of a given sentence. Everything considered, solving these problems seems to constitute a reasonably pleasurable experience for the student.

As required in the conditions for grammar practice set forth above, these sentence-combining activities elicit from the student the writing of a fully-formed sentence whose content has been provided in advance. Its structure is also pre-determined, and may be made to represent an unending variety of sentence types. Grammatical knowledge _per se_ is invoked only at the outset, when the student must decide from the transformation-rule tags how each kernel sentence should be transformed. In the case of relative embeddings, in fact, such tags are unnecessary. In rehearsing the full statement while forming it and appraising its grammaticality, the student experiences it repeatedly and thus in a particularly intensive manner. Lastly, he must retain the fully-formed sentence in memory while he writes it, and practice in this mnemonic skill may indeed be crucial. The findings reported by Harrell (1957), for example, may be interpreted as evidence that older students learn to keep sentences of increasing length in mind while their hands trace them on paper, whereas younger students cannot do this with facility -- a conclusion which would explain why the latter children write shorter sentences than they normally speak.

Furthermore, in being a-rhetorical, these problems are unaccompanied by whatever interferences attend the need to select sentences according to their appropriateness in larger contexts -- paragraphs, discourses, and finally the total rhetorical setting. The student is free to experience, intensively and without distraction, networks of intra-sentence relationships among increasing numbers of kernel statements appropriately formed and arrayed in context of the full sentences they comprise. The record of this experience, added to that representing the many occasions of naturalistic language use which the student encounters daily and which this practice merely supplements in a specially structured way, constitutes the basis out of which his maturing cognition presumably develops, and on which the subsequent production of mature language is thus contingent.

It should be emphasized that these sentence-combining problems were an integral part of the student's work in grammar. They were not represented as lessons in composition, nor should they be viewed as any kind of a "linguistic approach" to writing. As the rhetorician correctly notes, the writing act occurs only in response to some rhetorical occasion, and can neither be routinized nor artificially duplicated. As discussed below, it was assumed that schoolchildren would obviously continue to study full programs of composition along with their grammar courses. Furthermore, the sentence-combining practice was not advertised to the student as a simulation of the composition process. He was not expected to "imitate" patterns of practice sentences when he wrote, nor was he admonished to try to "use" sentence-combining strategies in any conscious manner. The assumption was simply that when he came to writing, the student would, as a natural result of prior sentence-combining practice, produce sentences whose structures would be more mature than those of the sentences he would otherwise have written.

Lastly, this sentence-combining practice did not represent an attempt to condition students to favor complexity of expression. Indeed, the term "complexity" is quite misleading and probably should be avoided. In general, of course, mature writing is on average more complex grammatically than is immature writing. But even here the notion of complexity may be construed in various ways. Complexity of deep structure, for example, differs from that of surface structure. Grammatical complexity is not the same as psychological complexity. Deviations from grammaticality, as in the case of metaphor, often produce complexity of a tantalizing sort, whereas deviations from acceptability, in the sense used by Chomsky (1965), produce a less desirable kind. What the rhetorician intends by "complexity" as a depreciatory term is not at all easy to define. Doubtless it covers a variety of ineptitudes, none of which one would wish to encourage. Enhanced growth of syntactic fluency, however, merely means that children of a certain age, after a given period of sentence-combining practice, would produce writing whose structural parameters had theretofore been associated with the normal productions of children some years older. It is unlikely that this writing would be considered undesirably complex.

Principal Curricular Assumptions

Clearly, a general curricular assumption underlying this experiment is that the secondary school English program will consist of three autonomous component subjects -- literature, composition, and linguistics. How this curriculum might be structured -- by how many teachers it might be taught, in how many different classrooms, and for how many hours weekly -- is an open question quite beyond the scope of this discussion. The point is only that in order to create appropriately a-rhetorical conditions for the sentence-combining practice, linguistic study must be viewed as an independent academic subject. No longer would it be considered an expendable activity defined solely in terms of its overt intracurricular utility relative to the goals of composition. It can be argued, of course, that these studies are independent and self-justifying without benefit of assumption. When presented as rational inquiry into the many aspects of human language behavior, linguistics leads to the acquisition of knowledge and the formation of attitudes which are humanistic in outlook, liberalizing, and in the long run of unquestionable worth.

In any event, one result of the above assumption was that composition instruction became an independent variable in this study. Insofar as possible, it was held constant for both the experimental and the control groups. Such an arrangement distinguishes the present experiment from the majority of its predecessors, which held in effect that the way to measure the results of grammar instruction in student writing is to have some of the students learn less grammar and practice more writing. In reality, these were experiments on various approaches to composition, and grammar was by implication viewed as no more than one such approach.

The position in this study, however, is that linguistics and composition are separate subjects in pursuit of separate goals, but that both can be accommodated in the English curriculum. It was assumed that the composition course would be an ideal one, featuring an optimal sequence of writing assignments and maximally helpful criticism of the student's written performance. But it was assumed further that the nature of this performance is also a function of the student's experiences with language encountered outside and prior to the composition class. Thus the general goal of this experiment was to determine whether the sentence-combining practice, an activity presented solely as an exercise in linguistics and not at all as a task in composition, might be counted as an instance of such prior language experience known to enhance the growth of syntactic fluency, although to do so in ways totally indiscernible to the student and thus quite "naturalistically."

A second outgrowth of the above assumption may be seen in the character of the grammar course in whose setting the sentence-combining problems were presented. The chief purpose of this course was neither to rectify the student's language behavior nor to facilitate the sentence-combining practice. Rather, it was to confront junior high school students, in an obviously introductory manner, with the problem of describing the language competence they and all other speakers already possess. As with contemporary studies in other curriculums, the main justification for this course was given in terms of the experiences and learnings generated by the inquiry it occasioned. Furthermore, as an activity designed to reinforce and further illustrate transformations earlier formulated by the student, the problem-solving practice was considered an integral part of the grammar course, and may be viewed in this light quite without regard for its possible effects upon syntactic fluency. Its role was very much like that of the straightforward exercises in formula application which are employed, for example, in modern secondary school algebra.

Procedural Assumptions

The seventh grade was selected as the level on which to conduct this experiment. It represents a time just in advance of the high school years, when the most noteworthy growth of syntactic fluency normally occurs among the students. Also, as the first year of junior high school, the seventh grade is in the writer's opinion the earliest point at which reasonably serious linguistic studies should be introduced into the curriculum. Despite these notions, however, the choice of grade level was actually quite arbitrary, as was the decision to confine the study to a single academic year. These topics are discussed further in the final chapter of this report.

Two assumptions pertaining to the measurement of syntactic fluency are also of importance. First, it is obvious that enough writing must be secured from each student to constitute a representative sample of his performance. Frogner (1933) and Hunt (1964) have shown that mode of discourse influences sentence structure counts. Consequently, the writing selections obtained from each student should range over a variety of modes, including at least narrative, expository, and descriptive. In any case, parameters of syntactic fluency cannot be extrapolated from observations based on single compositions. Anderson (1937) has demonstrated the complete unreliability of the 150-word samples used by LaBrant (1933), and recommends securing several times this much writing. Chotlos (1944) finds, however, that 1000-word samples are as reliable as ones of 3000 words in the case of junior high school students. Although no consistency studies are recorded for adult writers employing highly differentiated sentence structure, samples of 1000 words were assumed herein to be minimally adequate for schoolchildren. Since Hunt's eighth graders have a mean T-unit length of about 11 words, it was decided to collect per-student samples of 90 T-units. Such samples would represent at least six or seven compositions in as many discourse modes as possible.

Second, it is imperative that all writing represent the student's own free and uncoached responses to presented topics. The student must be allowed to write naturally, and above all he should not be made to feel that his sentence structure or any other single aspect of his writing is particularly on trial, or that he ought to affect any kind of artificial style. Obviously, he should be denied access to parental assistance or material which he might be tempted to plagiarize. It was thus decided that all writing examined in this experiment would be secured on an in-class basis under conditions similar to those of the one-hour Writing Sample used by the College Entrance Examination Board. The students were not told that their writing would be analysed, or even that an experiment was in progress. They were free to write partial or complete rough drafts and to revise their initial sentences in any way they desired. The only requirement was that they produce a finished essay on the given topic by the end of the class hour. Additional information on procedures used in securing the writing sample is given below.

Hypothesis and General Plan

The overall hypothesis of this study was that practice in transformational sentence-combining would enhance the normal growth of syntactic fluency. The rationale for this hypothesis, as alluded to throughout the foregoing discussion, was that such practice occasions intensive and undistracted experiences with sentences of mature grammatical form. These experiences, in turn, were assumed to count not only as specially structured instances of language input promoting the cognitive development on which subsequent mature output depends, but also as cases of the pseudo-production of such mature sentences in a way that provides their content in advance, thus bypassing the conception process and featuring only their construction and inscription. The sentence-combining practice was obviously intended as a supplement to, not a replacement of, the student's normal activities in reading and writing. Notice further that nothing in this rationale should be interpreted as an implied theory of cognitive processes. Indeed, the theoretical nature of these processes is one of the great unanswered questions in psychology today.

The plan of this study was to test the above hypothesis at the seventh grade level in an experiment of one year's duration. Samples of before and after writing were used as a basis for determining syntactic fluency. Comparisons of growth observed in the experimental group were made with the normative data advanced by Hunt (1964), as well as with the growth observed in equivalent before and after writing of students in two control groups. One of these groups studied traditional grammar and performed associated practice activities, and the other studied no grammar but read extra literature selections and received direct-method instruction in techniques for varying sentence structure when writing. Equal numbers of inter-test composition assignments were given to all three groups. Except as noted, the inter-test literature requirements were also identical throughout. The amount of sentence-combining practice experienced by the experimental group was the maximum possible, subject to two important conditions. It was not allowed to exceed the time block allotted to the grammar course, nor was it permitted to compromise the chief purpose of this course as given above. Detailed descriptions of the experimental treatments, and of the other design features, are given in the following chapter of this report.

Finally, it was obviously necessary to stipulate the amount of enhanced growth required in order for a confirmation of the hypothesis to be regarded as having educational significance. As shown by Hunt (1964), Harris (1962), and others, normal growth of syntactic fluency during the school years proceeds at glacial slowness. Indeed, differences in certain transform frequencies from one year to the next may not be great enough to attain statistical significance. Between grades four and eight, for example, Hunt's data show that children's per-year gains are one noun clause and one relative clause in each 100 T-units, although they become three clauses per year during high school. At the same time, however, schoolchildren have tremendous growth in store for themselves as they come to approximate adult norms. Surely the syntax of Harpers and Atlantic, Hunt's adult sample, is not beyond the potentiality of senior high school students. In any event, it was decided that an extra year's growth per year, or twice the normal rate, would be the minimum criterion specified in the hypothesis. This would mean in the long run that students completing grade nine, if they had begun programs of sentence-combining in grade seven, and if an enhanced growth rate had been sustained throughout the three-year period, would demonstrate an average syntactic fluency heretofore associated with twelfth graders. Clearly, such development would be most desirable within the present goal structure of the English curriculum.

CHAPTER THREE

DESIGN OF THE EXPERIMENT

Experiment Population

Subjects were selected so as to comprise a representative sample of seventh grade students. This sample, hereinafter termed the experiment population, numbered 247 students assigned to treatment groups as follows:

Group Name	Treatment Received	Number of Subjects
Experimental:	sentence-combining problems	100
Control:	traditional parsing exercises	100
Placebo:	no grammar (extra instruction in literature and composition)	47

Subjects were within the normal seventh grade age range, 12 to 13 years. All were white and native American. The numbers of boys and girls were roughly equal within each group. Participating schools were chosen to represent urban, suburban, and private education serving a clientele ranging from upper-middle to lower-middle class students. The schools were the following:

A. Belmont Hill School: a private, college preparatory day school for boys, located in the Boston suburb of Belmont, Massachusetts. Upper-middle class clientele.

B. Wellesley Junior High School: a public suburban junior high school in the Boston suburb of Wellesley, Massachusetts. Middle and upper-middle classes.

C. Washington Irving School: a public urban junior high school in the Roslindale neighborhood of Boston, Massachusetts. Middle class.

D. Woodrow Wilson School: a public urban junior high school in the South Dorchester neighborhood of Boston. Lower-middle class.

The general plan was to select three classes of students in each school, if possible on the same curriculum track, for assignment to the three treatments. Only school B, however, permitted classes to receive the placebo treatment. All students were given the STEP Writing Test, Form 3A, prior to the experiment. When the mean STEP scores of all subjects on a given curriculum track in each school were ranked without regard to treatment, the total experiment population was seen to represent five general ability levels, as shown in Table 2.

All students in the twelve classes participated in the experiment to the extent that all wrote before and after compositions and received their assigned treatments. After the post-test writing had been secured, students who had transferred into or out of a class during the year were dropped from the roster of subjects, as were others who had missed more than two compositions at either test time. In some classes, still others were eliminated by random draw in order to maintain balanced class sizes and keep the population total below 250 subjects, the maximum number whose writing could be analysed within the limits of available time and resources. The remaining students, whose numbers are shown in Table 2, thus became the actual subjects in the experiment.

Students in school B were assigned to treatment by the school official in charge of class scheduling, who assembled the classes which were to receive the three treatments by randomly drawing from pools of students slated for scheduling on each curriculum track. In the other schools, class schedules had already been made and could not be altered. Thus, entire classes were assigned to the two treatments in these

Table 2

Ability Levels Represented in the Experiment Population

Level	STEP	School	Group	Track	Class Size	Subjects
Highest	296	A (private)	Exp	1 - 3	15	9
			Con	2 - 3	16	9
High-average	288	B (suburban)	Exp	2 - 5	28	24
			Con	2 - 5	29	23
			Pla	2 - 5	28	24
Average	280	B (suburban)	Exp	3 - 5	29	23
			Con	3 - 5	27	24
			Pla	3 - 5	29	23
Low-average	271	C (urban)	Exp	1 - 7	35	23
			Con	2 - 7	37	22
Lowest	258	D (urban)	Exp	7 - 7	34	21
			Con	6 - 7	35	22
		Totals for the 12 classes:			342	247

STEP: The mean STEP Writing score for all students on the designated ability level.

Track: The first figure gives the curriculum level of each class, and the second the number of levels used by each school in its system for homogeneous grouping. Level 1 is highest.

Class Size: The average number of students enrolled in each class throughout the year.

Subjects: The number of students finally selected for the experiment population.

schools. Fortunately, however, the total experimental and control groups were indistinguishable on the basis of their mean STEP Writing scores. The same equivalence was observed between classes at each ability level except the highest, where the experimental class was superior to the control class. Table 3 shows the analysis of variance for STEP scores, as well as for scores on IQ and reading tests obtained from school records. Tests used were the following:

School A: Junior Scholastic Aptitude Test, Verbal (percentile scores); Traxler Silent Reading Comprehension (percentile scores)

School B: California Test of Mental Maturity (IQ scores, mean 100, SD 16); Iowa Reading Test (grade equivalent scores, test given in fourth month of seventh grade)

Schools C and D: Kuhlman Anderson (IQ scores, mean 100, SD 16); Stanford Reading Achievement (grade equivalent scores, test given in ninth month of sixth grade)

Apparent inconsistencies in degrees of freedom shown in Table 3 result from the fact that scores were unavailable for several of the subjects.

On the evidence of these independent measures, the experimental and control groups across the total experiment population were regarded as equivalent. The placebo comparison was confined to experimental and control classes matched with the placebo classes. Two-way analyses of treatment by sex and treatment by type of school were also possible. These sub-groupings are shown in Table 4. The students in school A, all boys, were omitted from the boy-girl grouping because there were no girls in the experiment on the highest ability level. Altogether, the various treatment groupings seemed equivalent in all major respects. Furthermore, the experiment population appeared representative of seventh grade

Table 3

Comparisons of Mean STEP, IQ, and Reading Scores
Between the Classes at Each Ability Level

Ability Level	Treatment Groups			F ratios tested at .05		
All Levels	Exp	Con	Pla	Obtained	Required	DF
STEP:	278.08	276.01		0.75	3.89	1,192
Highest						
STEP:	301.11	291.78		10.99*	4.49	1,16
IQ:	82.78	68.78		4.08	4.49	1,16
Reading:	81.63	59.13		8.89*	4.60	1,14
High-average						
STEP:	290.13	286.74	288.88	0.67	3.13	2,68
IQ:	128.57	128.57	126.70	0.38	3.14	2,62
Reading:	10.18	9.76	9.76	1.72	3.13	2,67
Average						
STEP:	281.18	279.13	280.32	0.19	3.14	2,64
IQ:	114.68	116.39	112.32	1.46	3.14	2,64
Reading:	9.05	8.96	9.13	0.08	3.13	2,66
Low-average						
STEP:	274.68	268.05		3.20	4.07	1,41
IQ:	119.58	115.56		1.89	4.11	1,35
Reading:	7.92	6.99		2.70	4.08	1,39
Lowest						
STEP:	254.76	261.35		2.58	4.08	1,39
IQ:	90.59	102.81		8.17*	4.15	1,31
Reading:	5.31	6.20		2.98	4.13	1,33

*Significant at or beyond the .05 level

Table 4

Experiment Population and Sub-Groupings

Level	Experimental		Control		Placebo	
	Boys	Girls	Boys	Girls	Boys	Girls
Highest	9*		9*			
High-average	12	12	11	12	12	12
Average	11	12	11	13	11	12
	Placebo Comparison					
	Suburban Group					
Low-average	10	13	11	11		
Lowest	11	10	11	11		
	Urban Group					

Group Sizes For the Several Comparisons:

Groupings	Experimental	Control	Placebo
Total Population:	100	100	47
Suburban Group:	47	47	
Urban Group:	44	44	
All Boys:	44	44	
All Girls:	47	47	
Placebo Comparison:	47	47	47

*These boys are omitted from the boy-girl groupings.

students in general, except that it included no culturally deprived "inner city" children.

Independent Variables

Subjects' extra-curricular language experiences obviously remained uncontrolled, as did the amount of collateral reading and writing they chose to do beyond the minimums required in their English courses. Rotation of treatments, which would have partially compensated for the above, was not feasible. Teachers and required subject matter in literature and composition were viewed as independent variables. These differed from school to school, but in every case the subject matter was constant across equivalent classes assigned to the several treatments. In other words, all subjects on each ability level read and discussed the same selections of literature and wrote the same number of compositions. (The placebo treatment included extra literature and composition instruction, but no additional writing assignments.) Each school had its English syllabus, and teachers agreed ahead of time to adhere strictly to the content prescribed. The method of analysing pre-post writing was not divulged to these teachers, who were asked to conduct their inter-test composition lessons and to evaluate student writing during this period just as they normally would if no experiment were in progress. Periodically during the year, the experimenter visited schools and conferred with teachers in order to insure that subject matter control was being maintained.

The teacher variable was not controlled, however, since it was impracticable to assign individual teachers to both experimental and control classes. For one thing, teaching schedules in schools A and B did not permit such an arrangement. Moreover, it was generally felt that the responsibility for teaching two different systems of grammar concurrently would discomfit even the best teachers, and might very well be disconcerting enough to nullify the desired control. Thus the experimenter had to be content with the hope that using several teachers for the classes in each treatment group (except placebo) would average out the effects of aberrant performances by individuals in any one of the groups.

All teachers who participated in the experiment did so voluntarily, and were highly recommended by their local supervisors and principals. Those who taught the experimental-group classes had previously expressed an interest in learning modern grammar and trying it in the classroom. These teachers began with some background knowledge of journal literature on transformational grammar. Two had examined it briefly during in-service courses, but none had studied it in collegiate settings. All five teachers were provided with textbooks and a self-study program which they pursued during the summer before the experiment. They then attended an intensive one-week workshop taught by the experimenter just prior to the opening of school, plus a one-day session between semesters. All received continuing supervision from the experimenter, who visited their schools bi-weekly but purposely avoided undue intrusions into their classrooms. Although they were remunerated for their workshop participation, these teachers are to be commended not only for the skill and diligence demonstrated in their learnings, but also for the highly proficient manner in which they fulfilled a teaching commitment which many less professionally oriented individuals would have refused to accept.

The control-group teachers in schools B and C were longstanding believers in traditional grammar and knew the subject thoroughly. The control teacher in school A stated that he taught grammar only because his school required it, although he did so thoroughly and without revealing his bias. The placebo teacher was pleased by the opportunity to experiment with direct-method composition instruction, and developed a set of materials for use on the overhead projector. Unfortunately, the control teacher in school D received a new teaching post at mid-year, and was replaced by a novice poorly trained in grammar. This new teacher also lacked the skills required to instruct children of low ability, and spent most of the semester in unsuccessful and no doubt discouraging attempts to gain a basic rapport with her students. On the whole, however, all teachers were conscientious and effective workers who spared no effort in their attempts to abide by the conditions of the experiment. The professional experience of these teachers is summarized in Table 5.

The Treatments

All groups devoted one third of their English class time to the respective treatments. The remaining time was given to required lessons in literature and composition. Students in school A had English five class-hours per week, and thus spent slightly over an hour and a half on their assigned treatments. Students in the other schools had six

Table 5

Academic Degrees and Prior Experience of Participating Teachers

School	Group	Degree(s) Held	Years of Service
A	Exp	BA, MA (English)	10
B	Exp	BS (Education)	4
B	Exp	BS (Education)	2
C	Exp	BS, MEd (Education)	7
D	Exp	BS, MEd (Education)	4
A	Con	BA, MA (English)	3
B	Con (2)	BA, MEd (Education)	20
C	Con	BS, MEd (Education)	14
D	Con	BS, MEd (Education)	3
D	Con	BA (English)	none
B	Pla (2)	BS (Education)	14

Teachers in school A were men. All others were women.

class-hours of English weekly, two of which were given over to the treatments in question. In addition, all students devoted one hour of out-of-class study per week to treatment activities. These weekly totals are averages, since most of the teachers preferred to divide a given class into separate lessons related to two or perhaps all three of the component subjects in their courses.

The texts specified in the curriculums of all schools were combined grammar and composition books widely used throughout the country. They were the following:

> School A: English Workshop, New Series, Grade Nine, by John E. Warriner and Joseph D. Blumenthal (New York: Harcourt Brace and Company, 1955)
>
> Schools B, C, and D: English Grammar and Composition: Grade 7, by John E. Warriner, John H. Treanor, and Norman H. Naas (New York: Harcourt Brace and Company, 1959)

Since these books contained required composition material, they were used by all students in the experiment. The experimental and placebo groups, however, omitted the section headed "Grammar," although their composition course required them to study the sections headed "Mechanics" (capitalization, punctuation, spelling), "Oral English," "Composition," and "Aids to Good English" (dictionary, library, vocabulary). The experimental group also omitted the "Usage" section, whereas the placebo group did not. The control group studied all sections.

The placebo treatment consisted of no formalized grammar study of any kind, although the students had previously learned the following terms: noun, verb, adjective, adverb, subject, predicate. These the teacher was permitted to use if desired. In lieu of grammar, this group was given one fourth more literature than normally required, direct-method usage exercises in addition to those included in their text, and composition lessons devised by their teacher. This instruction was conducted without recourse to grammatical nomenclature other than the items mentioned. The composition lessons consisted of a series of direct-method presentations of ways to vary sentence structure through use of inversions, post-noun adjective pairs, questions, novel vocabulary, and introductory constructions such as direct objects, adverbs, preposition phrases, and participle phrases -- all represented by example only.

The control group thoroughly studied the "Grammar" and "Usage" sections of their text, working out all given exercises during the course of the year. Briefly, the grammar section covered the following items: subjects and predicates (complete and simple, compound and non-compound); nouns (common and proper); adjectives; verbs (action, linking and auxiliary); adverbs; personal pronouns; preposition phrases (prepositions, noun phrase objects, adjectival and adverbial functions); coordinate conjunctions joining one-word constituents; subject complements (predicate nominatives and predicate adjectives); "object complements" (direct objects and indirect objects). The three kinds of practice exercises were the following: identification of given elements in example sentences, diagramming of sentences featuring these elements, and "use" of prescribed elements as blank-fillers in presented sentences. The number of practice sentences was approximately 800. All were simple sentences, in terms of the traditional grammatical sense of the word as well as of its meaning generally. Fewer than 100 featured pre-noun adjectives, adjectival preposition phrases, or compounded elements, and would thus be considered non-kernel (that is, other than "simple") in a transformational grammar.

The remarkable thing about all the practice sentences, however, is that they represented immature types which junior high school composition teachers rightly exhort their students to avoid, although the experimenter finds without exception that all widely used seventh grade texts are limited to these puerile sentence types. Apparently they are employed on the assumption that students of this age cannot learn to speak about the grammatical structure of more complex language. Not only is this untrue, it causes these students to experience and perhaps emulate sentences far below their attained level of syntactic fluency. Despite their manifest undesirability, these activities were chosen as the control treatment simply because they are conventional, established, and well-nigh ubiquitous in current seventh grade grammar programs.

The experimental group studied a transformational grammar written for the occasion by the experimenter. As are most classroom adaptations of transformational linguistics, it was derived from the theory advanced by Chomsky (1957 and 1962) and elaborated by Lees (1961) and others. The text was organized into three units. The first two spanned the period from September through December, and presented the notions of base rules, basic (kernel) sentences, and simple transformations. The third unit ran from January through May, and covered the several nominal and relative transformations, as well as pre-noun and post-noun reductions of the latter. Appendix A contains a brief discussion of considerations which entered upon the writing of this text, as well as a precis of its content. Although unit two introduced practice routines occasioning the transformational re-writing of basic sentences in their several alternate forms, it was during unit three that the sentence-combining problems were featured. Thus the experimental treatment *per se* was five months in duration, running from January through May of the school year.

The numbers and types of practice sentences comprising this treatment are shown in Table 6, which includes exercises given during units one and two of the course as well as the sentence-combining problems of unit three. "Pre-transformational basic sentences" occurred in unit-one lessons illustrating the form of a generative grammar and certain of its base rules. "Simple transformations" were given in unit two and required students to convert sentences to questions, inversions, negatives, or some combination thereof, or to recover the basic sentences present in such forms. "Separate complex transformations" were given as initial exercises in the lessons of unit three, and required students to convert basic sentences to the transform under study, for example, a derived-noun phrase, without embedding the transform in some other sentence. Of the sentence-combining problems, "single-embedding problems" occurred first in all lessons. These were followed by "multiple-embedding problems" featuring two, three, four, or more kernel sentences to be converted to any or all transforms earlier studied, and then to be embedded in single sentences. All practice sentences listed in Table 6 were contained in the grammar textbook, except that thirty of the multiple-embedding problems were given during the final three months of the year as separate five-minute daily problems required at the beginning or end of class periods when no grammar was studied. Relative proportions of transform types represented by the 904 kernel sentences included in the sentence-combining problems were approximately equal to the proportions of these types found in normal eighth grade writing, except that the proportion of pre-noun modifiers was considerably reduced. In fact, these were included only when they occurred with other relative transforms in

Table 6

Practice Sentences Comprising the Experimental Treatment

Total practice exercises of all forms: 602

Number of exercises of each form
    Pre-transformational basic sentences: 123
    Simple transformations: 130
    Separate complex transformations: 68
    Sentence-combining problems: 281

Number of single-embedding problems: 98

Multiple-embedding problems

Embeddings per problem:	2	3	4	5	6	7	8	9	10	11
Number of problems:	49	34	27	26	12	13	7	5	6	4

Total multiple-embedding problems: 183

Mean EKS* per sentence, total sentence-combining problems: 3.2

Mean EKS per sentence, multiple-embedding problems only: 4.4

Mean EKS per sentence, 30 problems given as daily exercises: 6.8

Total kernel sentences occurring in sentence-combining problems: 904

*embedded kernel sentences

clusters modifying single nouns. Illustrative sentence-combining problems are provided in Appendix B.

Procedure

The writing sample at each test time consisted of 90 T-units of prose composition secured from each subject. All writing was done in class under teacher supervision. Subjects received the topic stimulus at the beginning of each class period, and were required to submit a finished essay by the end of the hour. Topics were printed on slips of paper and distributed by the teachers, who were instructed not to rephrase or supplement the given wording. Subjects wrote nine compositions at each test time. These were evenly spaced throughout the first four weeks and the last four weeks of the school year. After each writing session, the compositions were collected by the teachers and submitted unmarked to the experimenter. The teachers did not participate in the subsequent analysis of this writing.

The nine topics were devised by the experimenter in consultation with the teachers. Each topic was represented in parallel "A" and "B" forms. Classes which received one of these forms at pre-test were given the other form at post-test. Parallel forms were used in order that writing produced at both test times would be in response to stimuli as nearly identical in nature as possible. The two forms of the topic requiring a character sketch, for example, differed only in that one sketch was to be of a person related to the student, the other of a non-relative. Forms A and B of the nine topics are given in Appendix C exactly as they were presented to students. A general listing of these topics and their discourse modes is as follows:

Number	Mode of Discourse	Topic
1	narrative	non-fiction anecdote
2	descriptive	one-time one-place sensory impressions
3	expository	informative essay on modern living
4	narrative	fictional "fantasy" experience
5	expository	"how to do it" process essay
6	descriptive	"typical day" reported to pen pal
7	expository	explain and discuss an aphorism
8	descriptive	non-fiction character sketch
9	expository	argument and persuasion

To avoid any systematic bias which might have resulted from the A and B forms, these were assigned in the balanced way shown in Table 7. All classes on equivalent ability levels received the same forms at each test time. But the forms received by classes comprising given treatment groups were equally divided between A and B, so that no group wrote only on one of the forms at either test time.

The students were not told in September that they would write again in the spring, nor was the actual nature of the experiment described to them. The experimental classes were aware, naturally, that their grammar course was innovative. But the relationship between this course and the pre-post writing was not discussed. These tactics were necessary, it was felt, to prevent distortions in post-test writing which might have resulted from some form of resentment on the part of control classes, or from conscious attempts by the experimental students to imitate their practice sentences in some unnatural manner. It was

Table 7

Assignment of Pre-Post Topic Forms

Group	Level	Pre-Test Form	Post-Test Form
Experimental:	Highest	B	A
	High-average	A	B
	Average	B	A
	Low-average	B	A
	Lowest	A	B
Control:	Highest	B	A
	High-average	A	B
	Average	B	A
	Low-average	B	A
	Lowest	A	B
Placebo:	High-average	A	B
	Average	B	A

decided that the pre-test writing would be presented as a project sponsored by several teachers in the subjects' schools, who wished to discover how well the students had learned to write in elementary school and what their particular needs were. Hence, the topics bore the formidable title "Diagnostic and Achievement Measurement." Three of the pre-test compositions were photo-copied by the experimenter and returned to the teachers, who redistributed them to students after all writing had been completed, subsequently using them for the purposes announced. Post-test writing was presented as an attempt to learn how much the students had improved in their writing ability during the course of the year. At both test times, students were admonished simply "to write as well as they could" on the given topics. Because the students in the fall were new to junior high school and its routines, the teachers recommended a preliminary practice composition, an autobiography, which was neither counted in the experiment nor repeated in the spring.

Writing was segmented and analysed by the experimenter and specially trained assistants. The first ten T-units from each of a subject's nine compositions at each test time were listed together, thus comprising the sample of 90 T-units per subject per test. The rules for T-unit segmentation are as follows:

1. Each independent clause, including all constituent constructions, counts as one T-unit.
2. Clauses of condition, concession, reason, and purpose (although traditionally considered constituents of independent clauses) also count as separate T-units.
3. Independent clauses occurring as directly quoted discourses count as T-units. Speaker tags are discarded.
4. Orthographic sentence fragments count as part of the T-unit to which they belong.
5. True fragments resulting from the omission of a single word count as T-units with the missing word supplied. Other true fragments are discarded.
6. Unintelligible word strings, vocatives, interjections, and various parenthetical or a-syntactic expressions found in conversational writing, are discarded.
7. Independent clauses differing from preceding clauses only in

their subject, and thus elliptical beyond their verb auxiliary, are discarded.

These procedures are essentially the same as those employed by Hunt (1964). Item two, however, follows from the experimenter's view that logical conjunctions ("if," "although," "because," "so that," etc.) are T-unit connectors much like the coordinate conjunctions, in that both groups of words join independent clauses. Item seven also differs from Hunt's routine. It represents an attempt to discard clauses with repeating, thus elliptical and vacuous, predicate phrases, such as "and so did John" or "but neither could the man," which otherwise would count as T-units.

The total number of T-units processed in the experiment was 43,826, which represented 462,543 running words. An inventory of T-units and words is given in Table 8. The modest shortage of T-units results from student absences during writing sessions. The initial estimate was that students could miss up to two compositions and still be likely to produce 90 T-units. Teachers were allowed to proceed on this assumption, since makeup sessions were difficult to arrange. In fact, however, many of the students who missed compositions failed to achieve the required number of T-units. It was not felt that these shortages compromised the adequacy of the sample, however, nor did they distort the subsequent construction counts, since these were in all cases converted to a base of 100 T-units, as is discussed below.

Table 8

Inventory of All T-Units and Words in the Writing Sample

Group and Level	Subjects	Pre-Test		Post-Test	
Experimental		T-units	Words	T-units	Words
Highest	9	810	9,324	810	11,348
High-average	24	2,145	23,067	2,160	26,850
Average	23	2,065	21,079	2,070	23,623
Low-average	23	2,030	19,314	2,039	21,937
Lowest	21	1,817	16,707	1,876	18,703
Totals:	100	8,867	89,491	8,955	102,461
Control					
Highest	9	774	8,555	810	8,978
High-average	23	2,070	21,597	2,070	24,132
Average	24	2,124	21,265	2,160	23,402
Low-average	22	1,980	18,686	1,971	18,224
Lowest	22	1,829	17,870	1,837	16,221
Totals:	100	8,777	87,973	8,848	90,957
Placebo					
High-average	24	2,160	22,715	2,123	25,082
Average	23	2,030	21,150	2,066	22,714
Totals:	47	4,190	43,865	4,189	47,796
All Groups, Totals:	247	21,834	221,329	21,992	241,214
Mean sample-size per subject:		88.4	896	89.0	977

Dependent Variables

The main dependent variables in the experiment were twelve factors of syntactic fluency. These were derived arithmetically from construction-count data generated by the grammatical analysis of each T-unit in the writing sample. These factors reflect either the number or the frequency of constructions whose increased use stipulatively defines the growth of syntactic fluency which the experimental treatment was designed to enhance. Thus these factors pertain for the most part to nominal and relative embeddings, clustered modification, and depth of embedding. The following section outlines procedures employed in the grammatical analysis of T-units, then presents the methods by which the several construction-count totals were converted to factors of syntactic fluency.

The grammatical analysis of T-units was conducted by the experimenter and assistants. Procedures were standardized during the first several weeks of work, when it was necessary to incorporate and follow up a great many arbitrary rules for identifying the sometimes bewilderingly diverse structures found in ordinary written language. The main goal was to differentiate deep-structure embedded sentences from other constituents, and of the former to note only those realized as nominal or relative transforms. All procedural decisions were made by the experimenter. Assistants were at all times unaware of the treatment group from which T-units under analysis had been taken. The assistants' findings were confirmed by the experimenter for all T-units longer than twenty words, and for others on a systematic spot-check basis. The initial plan to note unique grammatical patterns represented either by whole T-units or by dominant nominals was rejected as excessively time-consuming. Approximately six months were required for the analysis as performed. Altogether, eleven frequency counts were made. The procedural rules for these counts are given below.

Item A - Number of Words: The number of separate orthographic elements in each T-unit. Compound nouns written solid counted as one word. Compound nouns written as two words, and hyphenated word pairs, counted as two words. Phrasal proper names, dates, and aphorisms quoted from composition topic number seven, all counted as one word.

Item B- Number of Nouns: The number of nouns, including indefinite "some" terms, prop-nouns ("thing" and "one"), and verbal nouns lacking deep-structure subjects and complements. Phrasal proper names counted as one noun. Possessive pronominals ("mine" and "yours") and noun adjuncts in compound nouns were not counted.

Item C - Instances of Intra-T-Unit Conjunction: The number of instances of coordinate conjunction of elements within the T-unit, whether additive or disjunctive, positive or negative. Where greater than two, the number of elements conjoined in each instance was also noted. Parallel modifiers of nouns were not counted except where linked by an actual conjunctive word.

Item D - Number of Nominal Clauses: The number of factive and interrogative clauses occurring in nominal positions, including appositive clauses ("The fact that it rained amused him"). "Wh+ever" clauses ("He did whatever she asked") were also counted, although these are perhaps derived from relative clauses. Adjective complements ("He was glad that she was sad"), and fact-like comparative clauses ("It was so cold that his feet froze"), did not count.

Item E - Number of Nominal Phrases: The number of gerund, infinitive, and derived-noun phrases occurring in nominal positions. Gerundive phrases ("He left without saying a word") also counted, although these are probably derived from conjoined sentences. To count as a phrase, a verbal had to retain at least one constituent from its deep structure -- subject, object, or complement. ("The man's arrival" and "the settlement of the case" would count, but "the arrival" and "the settlement" would not.) The following constructions did not count: adjective complements ("He was anxious to please her"), infinitival predicate complements ("He forced her to leave"), and catenated verb phrases. ("He tried to fry the rice" would not count. "He tried frying the rice" would.)

Item F - Number of Relative Clauses: The number of unreduced relative clauses. Although traditionally labeled adverbial, clauses of time, place, and manner were counted as relative clauses whose head nouns had been deleted.

Item G - Number of Relative Phrases: The number of post-noun modifying phrases derived in the reduction of relative clauses, including preposition phrases, genitive phrases, participle phrases, and infinitives and infinitive phrases. Appositive noun phrases and appositive adjective pairs were counted, although nonrestrictive appositives are now said to derive from conjoined sentences. As noted above, appositive clauses were counted as nominal clauses and were not counted again in the present category. Reductions of relative clauses of time, place, and manner did not count. ("He sings when he bathes" would count as a relative clause, but "He sings when bathing" would not be counted at all.) "Of" phrases sometimes called pre-determiners ("several of the boys" and "a bushel of wheat") were not counted, even though they are perhaps formed from embedded sentences. "Of" phrases carrying deep-structure subjects and objects in verbal phrases ("the winning of the West") were not counted. Other "of" phrases which clearly modified head nouns were counted, although their derivation from relative clauses is not always apparent ("structures of cognition," "the point of no return," "a grammar of rhetoric," "a fist of mail," etc.). Nonrestrictive participial phrases ("Thinking quickly, he answered") also counted, although they no doubt derive from conjoined sentences, and do not necessarily occur in post-noun positions.

Item H - Number of Relative Words: The number of pre-noun modifiers derived in the reduction of relative clauses, including adjectives, participles, possessives, participial compounds of various forms, and the adjuncts in endocentric compound nouns. Articles, demonstratives, and enumerating and quantifying determiners were not counted.

Item I - Number of Modifiers in Largest Cluster: The largest number of relative clauses, relative phrases, and/or relative words modifying any single noun in the T-unit. Two or more modifiers constitute a cluster. A zero entry was made where the T-unit contained no clustered modification whatever.

Item J - Depth Level of Most Deeply Embedded Sentence: The level number of the sentence occurring at the deepest point of recursive, or "nested," embedding. Thus, "He knew that the boy was correct" is level one. "He knew that the boy with the chalk was correct" is level two. "He knew that the boy with the yellow chalk was correct" is level three. "The man with the answers knew that the boy with the yellow chalk was correct" is still level three. Only those transforms listed above in items D through H were regarded as embedded sentences. Other embeddings, such as adjective complements, were ignored. Thus, "He was sure that kicking it was unfair" is level one, not two. A zero entry was made where the T-unit contained no embeddings of the types noted above.

Item K - List of Logical Conjunctions: Conjunctions joining independent clauses, and thus usually the first word in a given T-unit, were listed according to the logical relationships they expressed: additive, adversative, causal, conditional, concessive, illative, purposive, and disjunctive. "So" and "then" were also listed when occurring as the first word of a T-unit. In general, logical conjunctions are drawn from three traditionally separate word categories: coordinate conjunctions ("and" and "or"), subordinate conjunctions ("because" and "although"), and independent adverbs or sentence connectors ("therefore" and "moreover").

The twelve factors of syntactic fluency are given below. These were derived from the frequency counts just described, which were first summed over on a per-student per-test basis. Obviously, many other combinations of these frequency-count totals are also possible. A number of such additional combinations were used as secondary dependent variables, as was the information from items B and K, which is nowhere incorporated in the twelve factors. These secondary variables will be described in the following chapter at the time of their mention.

Dependent Variables: Twelve Factors of Syntactic Fluency

Mean T-Unit Length

Total words counted (item A) divided by total T-units.

Subordination-Coordination Ratio

Total embedded sentences (sum of items D, E, F, G, and H) divided by total added sentences (computed from item C, where total elements conjoined minus total T-units equals total added sentences).

Nominal Clauses Per 100 T-Units

Total nominal clauses (item D) divided by total T-units, quotient times 100.

Nominal Phrases Per 100 T-Units

Same as above, using item E.

Relative Clauses Per 100 T-Units

Same as above, using item F.

Relative Phrases Per 100 T-Units

Same as above, using item G.

Relative Words Per 100 T-Units

Same as above, using item H.

Embedded Kernel Sentences Per 100 T-Units

Sum of items D, E, F, G, and H divided by total T-units, quotient times 100.

Cluster Frequency

Percentage of T-units containing one or more clusters,(computed from item I, total instances of non-zero entries divided by total T-units, quotient times 100).

Mean Cluster Size

The average number of modifiers in the largest cluster noted in each T-unit, (computed from item I, the sum of total instances of "2" entries times 2, plus total instances of "3" entries times 3, etc., divided by total instances of non-zero entries).

Embedding Frequency

Percentage of T-units containing one or more embedded sentences, (computed from item J, total instances of non-zero entries divided by total T-units, quotient times 100).

Mean Maximum Depth Level

The average level of the most deeply embedded sentence in T-units containing one or more embeddings, (computed from item J, the sum of total instances of "1" entries, plus total instances of "2" entries times 2, plus total instances of "3" entries times 3, etc., divided by total instances of non-zero entries).

CHAPTER FOUR

RESULTS AND DISCUSSION

Pre-Post Growth Measurement

The first step in the analysis of data was to determine whether statistically significant pre-post growth had occurred in the experimental and control groups when examined separately. Mean change scores on the twelve factors of syntactic fluency were analysed within each group by t-tests for correlated measures. The results of these analyses and the means obtained at each test time are shown in Table 9. Remarkably, the experimental group experienced significant pre-post growth on all twelve factors. As anticipated, however, growth in the control group was so slight as to be virtually indiscernible. This fact bears out the conjecture expressed earlier based on Hunt's data, that normal growth over a nine-month academic year, as experienced under the typical classroom conditions represented by the control treatment, would not be of sufficient magnitude to attain statistical significance. But notice that the obtained means on eight of the twelve factors are greater at post-test than at pre-test. This trend may be interpreted as evidence that growth did occur in the control group, although at an extremely low rate.

The most perplexing aspect of the control group behavior is the significant decrement recorded on the nominal phrase factor. No satisfactory explanation of this phenomenon has occurred to the experimenter.

Table 9

Analysis of Mean Pre-Post Change Scores within the Experimental and Control Groups on the Twelve Factors of Syntactic Fluency

Factor	Experimental Group				Control Group			
	Group Means			t-ratio	Group Means			t-ratio
	Pre	Post	Change		Pre	Post	Change	
Words	9.98	11.25	1.27	7.47**	9.94	10.20	0.26	1.86
S/C R	4.35	5.76	1.41	5.88**	4.40	4.85	0.45	2.14*
N Cls	14.37	17.76	3.39	4.58**	13.25	12.58	-0.67	0.91
N Phs	5.86	9.74	3.88	7.92**	6.36	3.96	-2.40	4.29**
R Cls	22.08	28.37	6.29	6.29**	21.40	22.86	1.46	1.62
R Phs	31.91	47.66	15.75	9.55**	31.27	35.79	4.52	2.79**
R Wds	64.60	87.82	23.22	10.27**	66.72	69.72	3.00	1.36
E K S	138.65	191.30	52.65	13.00**	139.00	144.83	5.83	1.51
Clu F	16.25	22.71	6.46	8.73**	15.50	17.94	2.44	3.09**
Clu S	2.17	2.23	0.06	3.00**	2.18	2.16	-0.02	1.00
Emb F	67.78	77.13	9.35	10.39**	66.69	67.49	0.80	0.83
Depth	1.33	1.50	0.17	8.50**	1.33	1.33	0.00	0.00

DF: 99
t-ratio required at .05: 1.98
t-ratio required at .01: 2.63
*significant at or beyond the .05 level
**significant at or beyond the .01 level

Note: The following factor-name abbreviations also appear in subsequent tables.

Words: mean words per T-unit
S/C R: subordination-coordination ratio
N Cls: nominal clauses per 100 T-units
N Phs: nominal phrases per 100 T-units
R Cls: relative clauses per 100 T-units
R Phs: relative phrases per 100 T-units
R Wds: relative words per 100 T-units
E K S: embedded kernel sentences per 100 T-units
Clu F: cluster frequency per 100 T-units
Clu S: mean maximum cluster size
Emb F: embedding frequency per 100 T-units
Depth: mean maximum depth of embedding

Inspection of individual gains scores, which are given in Appendix D for all subjects in the experiment population, reveals that the decreases on this factor were fairly evenly distributed throughout the five ability levels represented in the control group. Control subjects on the high-average and average ability levels had a mean pre-test standing far above that of both the experimental and placebo subjects with whom they were matched. Their post-test standing fell to a point where it was indistinguishable from that of the placebo group, whose level remained stable throughout. Although marked increases on this factor were noted at all levels in the experimental group, the absolute totals of these transforms were everywhere the lowest of the five transform types counted. Thus it may be the case that 90 T-units of writing is an inadequate sample in which to expect consistency of nominal phrase occurrences.

Clearly, however, significant growth occurred in the writing of the experimental group. Some idea of the magnitude of this growth may be obtained by comparing post-test standings and mean per-year gains on the five transform types with the findings reported by Hunt (1964). These comparisons are shown in Table 10. The control group gains are included for suggestive comparison only, since they are insignificant statistically. The figures credited to Hunt are based on the converted data reported earlier in Table 1, except that clauses of time, place, and manner are now included in the relative clause total, and genitive constructions have been included in the relative phrase and relative word totals. In every case, the gains achieved by the experimental group are such that the growth rates inferred therefrom are more than twice the rate of

Table 10

Comparisons of Post-Test Totals and Group Gains Scores with Hunt's Parameters of Normal Growth

Factor	Totals Per 100 T-Units			Per-Year Gains			Exp Growth
	Hunt 8th	Con	Exp	Hunt Av	Con	Exp	
N Cls	12.7	12.6	17.8	+1.0	-0.7	+3.4	3.4
N Phs	10.1	4.0	9.7	+1.1	-2.4	+3.9	3.5
R Cls	17.8	22.9	28.4	+1.8	+1.5	+6.3	3.5
R Phs	49.9	35.8	47.7	+7.6	+4.5	+15.8	2.1
R Wds	86.3	69.7	87.8	+7.4	+3.0	+23.2	3.1

Hunt 8th: totals given by Hunt for grade 8, converted to a base of 100 T-units

Hunt Av: the average yearly growth between grades 4 and 8, based on Hunt's totals converted as above

Exp Growth: the number of "years" of growth achieved during one year by the experimental group, based on averages from Hunt normal growth as indicated in Hunt's findings. This fact satisfies the conditions for adequacy of growth rate stipulated in the experiment hypothesis. It is not known, of course, whether these gains are permanent or how long the enhanced growth rate might be sustained were similar forms of sentence-combining practice required during subsequent years. These questions might profitably be asked in future research.

Table 10 also compares the post-test standings of the experimental and control groups with the parameters given by Hunt. Notice that the experimental group exceeds eighth grade norms on three of the five factors. These comparisons are of relatively minor importance, however, since statistical tests for significance of difference are not possible, and the topic stimuli and no doubt the analytical procedures differ as between this study and Hunt's. The more interesting comparison is obviously that between the experimental group and the control group in the present study. Notice that the control group standings actually constitute a more valid description of normal developmental levels than do Hunt's findings, since they are based on a population over five times larger than Hunt's and more generally representative of schoolchildren at large.

Experimental-Control Comparison

Thus the second step in the analysis of data was to compare the post-test standings of the experimental and control groups in order to determine whether the growth experienced by the experimentals was significantly greater than that of the controls and could thus be attributed to the sentence-combining practice. Inspection of the group means at each test time gave every evidence that this would be the case. Although the similarity of pre-test means indicated that the two groups were evenly matched at the outset, the pre-test measures were used as covariates in the one-way analyses of variance comparing mean post-test scores on the twelve factors. The covariance procedure subtracts that part of the between group variance attributable to pre-test differences, and thus artificially matches the two groups. Table 11 shows these post-test comparisons. Notice that the adjusted means differ only slightly from the obtained means.

It should be pointed out that F-ratios were significant on three factors for the test of H-1, Bartlett's test of homogeneity of group dispersions. The factors in question were length of T-unit, number of nominal clauses, and depth of embedding. Square root transformations of these data reduced the size of the H-1 F's, although they remained significant. Inspection of frequency distributions for the three factors (cf. Appendix D) revealed a right skewness in the experimental group which had no counterpart in the control group. But the main F-ratios were fairly large, and it was apparent that the two groups would differ even if only the data in the center and left portions of the experimental group curves were used. In other words, the standings of the experimental subjects were higher than those of the control subjects, except that a few were very much higher. Thus it was decided that the significant F-ratios in the H-1 test could be overlooked.

The following observations may be made in reference to the data

Table 11

Comparison of Post-Test Mean Scores of the Experimental and Control Groups on the Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried

Factor	Obtained Means		Adjusted Means		F-Ratio
	Exp	Con	Exp	Con	
Words	11.25	10.20	11.24	10.22	22.30**
S/C R	5.76	4.85	5.77	4.84	11.98**
N Cls	17.76	12.58	17.70	12.64	38.27**
N Phs	9.74	3.96	9.79	3.91	120.38**
R Cls	28.37	22.86	28.23	23.00	19.30**
R Phs	47.66	35.79	47.45	35.99	26.78**
R Wds	87.82	69.72	88.57	68.98	40.36**
E K S	191.30	144.83	191.44	144.68	71.00**
Clu F	22.71	17.94	22.53	18.12	20.11**
Clu S	2.23	2.16	2.23	2.16	9.74**
Emb F	77.13	67.49	76.88	67.73	64.08**
Depth	1.50	1.33	1.50	1.33	81.18**

DF: 1, 197

F-Ratio required at .05: 3.90

F-Ratio required at .01: 6.78

**significant at or beyond the .01 level

in Table 11. In mean T-unit length, the groups were almost exactly even at pre-test, but by post-test the T-units of the experimentals had become just over one word longer than those of the controls. The yearly increment reported by Hunt is 0.7 of one word. Thus the experimentals gained a lead over the controls representing nearly one and a half years of extra growth. The subordination-coordination ratio, in turn, was devised in light of the frequently expressed belief that maturing students come to use less coordination and more subordination as their writing skills develop. This ratio may be understood as the number of kernel sentences added into T-units by subordination for each kernel sentence added by coordination. Again the two groups started about even, but by post-test the experimentals were employing nearly one more subordinate structure for each coordinate one than were the controls. In numbers, the experimentals subordinated approximately six kernel sentences for every one coordinated, whereas the controls subordinated just under five for one.

Growth rates of the five transform types have already been compared with the normal rates inferred from Hunt. The significance of this enhanced growth, when compared with the standings of the control group, would appear to be self-evident. Summing the five types in the total EKS factor, one observes that whereas the two groups were exactly matched at pre-test, the experimentals at post-test were writing 32% more of these structures in a given number of T-units than were the controls. Interpreting the figures another way, after an even start, the experimentals ended the year writing 1.9 embedded or secondary statements on average per independent clause, while the controls ended the year averaging 1.4 embedded statements. This is indeed a significant enhancement of the developmental process in which gradually, over the years, child-like writing becomes mature adult prose. Notice, however, that the structural differences between the post-test writing of the experimental and control groups probably would not catch the eye of most readers. A sixteen-T-unit composition, for example, would differ between the two groups on average by a total of eight embedded sentences. It is unlikely that even a trained rhetorician, if he were reading for general content and expression, would remark this difference. At the same time, the structural features of writing more widely separated on the developmental scale are quite apparent. Thus the ultimate importance of the added growth experienced by the experimental group becomes evident only when this growth is projected over a period of several years. Such a projection, as suggested earlier, is contingent upon subsequent research determining how long the enhanced growth may be sustained by continued treatment.

The two factors pertaining to modifying clusters show what is perhaps less dramatic growth on the part of the experimental group. These factors, like the subordination ratio and the indices of frequency and depth of embedding, are unique to this experiment and thus cannot be compared with norms taken from established developmental studies. It would be useful to know, for example, how frequent and how large are the clusters found in twelfth grade and adult writing, since this information would enable one to appraise the significance of the extra growth experienced by the experimental group. In any event, the growth on both these factors was statistically greater than that of the control group. Notice that the increased frequency of embedding is somewhat easier to interpret. The experimentals embedded one or more sentences in approximately 77% of their T-units, an extra gain of about 9% over what the controls achieved. The absolute ceiling is of course 100%, and adult writing probably averages upwards of 95%. But a gain of 9% would appear to be an important increase indeed. Finally, the figures reported on maximum embedding depth mean that on average in the control group every third T-unit with one or more embedded sentences also contained an embedding within an embedding, whereas in the experimental group this occurred on average in every second T-unit having one or more embedded sentences. In actuality, of course, individual T-units occurred in both groups whose embeddings reached the fifth, sixth, and seventh levels, as did sequences of several T-units containing either one embedding each or no embeddings whatever.

Comparisons on eight additional factors of syntactic fluency are shown in Table 12. The fact that the experimentals wrote a significantly greater number of nouns per T-unit than did the controls is a predictable consequence of their having embedded more sentences per T-unit. The modification ratio indicates roughly that the experimentals modified 74% of their nouns, whereas the controls modified only 61% of theirs, a difference of 13%. The averages are inflated and the differences exaggerated somewhat, however, since some of the modifiers, and more of them in the case of the experimental group, are actually in clusters surrounding the same noun. The significant difference on number of sentences added by intra-T-unit coordinate conjunction was not initially hypothesized. In

Table 12

Comparison of Post-Test Mean Scores of the Experimental and Control Groups on Eight Additional Factors of Syntactic Fluency, with Pre-Test Scores Covaried

Factor	Obtained Means		Adjusted Means		F-Ratio
	Exp	Con	Exp	Con	
Nouns/T-Unit	2.18	2.05	2.19	2.05	6.20*
Mod Ratio	0.74	0.61	0.74	0.61	80.13**
Logical Cons	12.58	11.52	12.65	11.45	2.87
And-So-Then	12.34	12.81	12.65	12.50	0.02
Conjoinings	29.37	26.38	29.42	26.33	6.68*
All Nominals	27.45	16.40	27.38	16.47	126.86**
All Relatives	163.85	128.07	164.25	127.67	46.71**
Phrase-Clause	103.53	75.18	102.82	75.89	72.22**

Nouns/T-Unit: the mean number of nouns counted in each T-unit

Mod Ratio: modification ratio, total relatives to total nouns

Logical Cons: number of inter-T-unit logical conjunctions per 100 T-units

And-So-Then: number of these conjunctions as T-unit connectors per 100 T-units

Conjoinings: instances of intra-T-unit coordinate conjunction per 100 T-units

All Nominals: nominal phrases plus nominal clauses per 100 T-units

All Relatives: relative words plus relative phrases plus relative clauses per 100 T-units

Phrase-Clause: total embedded sentences minus relative words per 100 T-units

DF: 1,197
F-Ratio required at .05: 3.90
F-Ratio required at .01: 6.78
*significant at or beyond the .05 level
**significant at or beyond the .01 level

retrospect, however, it is obvious that embedded sentences may contain conjoined constituents, and nominal embeddings may themselves be coordinated. (Conjoined relative embeddings, of course, are clusters.) Thus the slight although statistically significant increase in conjoining may be regarded as a concomitant rather than a direct result of the increased embedding brought about by the sentence-combining practice.

On the other hand, the absence of significant difference on the logical-conjunction factor was predicted at the outset. There was no reason to believe that experiences with practice sentences featuring only nominal and relative embeddings would result in greater use of, for example, conditional, causal, or concessive subordination. In other words, the experimental treatment acts only upon those aspects of sentence structure which it exemplifies. Indeed, this is to say that it functions exactly as hypothesized. It would of course be interesting to study the effects of similar kinds of sentence-combining practice in grades eight and nine, where the practice problems could be increased in scope so as to range over logical conjunction of various types.

Turn now to the occurrences of inter-T-unit coordinate conjunction as effected by the "and," "so," and "then" connectors. Here it was initially hypothesized that the sentence-combining practice would drive out a good deal of what is usually regarded in elementary and junior high school writing as the excessive coordination of independent clauses. The often-cited assumption underlying this hypothesis was that much of the content appearing as independent clauses in immature writing later, in more mature prose, appears in the form of embeddings in adjacent clauses.

Notice, however, that the groups do not differ either significantly or apparently at all on this factor. Thus it would seem that the above assumption is in need of re-examination. While the very youngest writers may produce "I saw a lady and she was fat," this almost certainly has become "I saw a fat lady" by the junior high years. And at no time is it believable that students write as independent clauses sentences in need of nominalization. Thus the more likely conclusion is that older students actually are inspired to make additional secondary statements in each independent clause, rather than merely to collapse therein the content of what it earlier would have occurred to them to write separately. In a word, the differencesbetween mature and immature writing are the result more of elaboration than of condensation. On this view, the failure of the experimental treatment to reduce the incidence of inter-T-unit coordination is not surprising. At the same time, of course, the increases on the main factors of syntactic fluency are clear evidence that the independent clauses of the experimental group have become significantly more elaborated.

The final three factors reported in Table 12 are merely recombinations of the five separate transform counts. If one assumes that the growth of the experimental subjects might in fact have been only a response to some form of covert prompting requiring them to affect an unnaturally complex style, it would follow that a disproportionate excess of relative over nominal embeddings would occur, since the former are obviously easier to "imitate." Notice, however, that whereas the control group wrote approximately eight times as many relatives as nominals, the experimental group wrote only six times as many. Furthermore, the phrase-clause factor shows that the difference between the total EKS of the two groups did not result only from a tendency of the experimentals to pack their sentences with adjectives and other pre-noun modifiers, although these constructions are of course the most numerous of the five transform types in both groups, as they are in writing generally.

Everything considered, the experimental group as a whole clearly experienced significantly more growth than did the control group. Furthermore, given the design features of the study, it would seem that this extra growth may be unequivocally attributed to the experimental treatment. It is true that the control group was subjected to error-oriented usage drills in addition to their study of syntax, whereas the experimental group was not. But both groups were held accountable for errors committed on their inter-test compositions. On the one hand, the approach to usage drills on the part of the control teachers did not appear to be unduly aversive, and on the other, the red corrector's ink was observed to flow liberally in the inter-test themes of the experimental group. Thus it is unlikely that fear of committing errors disproportionately influenced the post-test performance of either group. It is also true that novelty of treatment, the so-called Hawthorn effect, may have affected the post-test writing of the experimental group. If so, this may be regarded as an altogether fortuitous happening, since transformational grammar and the associated sentence-combining practice would be novel to each succeeding generation of seventh graders. The chief problem would be to sustain the novelty during grades eight and nine.

With regard to this last remark, it is apparent, as has been suggested above, that the enhanced gains experienced over a one-year period are probably not in themselves sufficient to be considered educationally meaningful in the long run. At the same time, however, if one conceives of a three-year program of more or less similar sentence-combining practice extending through grades seven, eight, and nine, and if subsequent research shows that gains are both durable and capable of being sustained at an equivalent rate throughout this three-year period, then it is clear that truly significant contributions to growth of syntactic fluency are in the offing. It may be the case that there is a ceiling well below adult norms which student writing cannot be made to exceed. It may also be the case that the enhancement is actually quite slight during the first year, but will increase geometrically thereafter, Obviously, the practice activities in grades eight and nine could be made to range over a greater variety of structures than the nominal and relative embeddings featured in the grade seven practice. Thus it is possible to speculate that ninth graders could on average be brought to a level of syntactic fluency presently associated with typical twelfth graders. It is difficult to imagine that such an eventuality would be regarded as other than highly desirable by the composition teacher and others who view the improvement of writing as the main goal of English, particularly since the enhanced growth would occur naturally and would derive from activities conducted in that part of the English curriculum set aside for linguistic studies.

Placebo Comparison

As noted earlier, the placebo comparison examines the performance of the 47 subjects in the placebo group as compared with that of the equal numbers of subjects in the control and experimental sub-group with whom they were matched. Subjects comprising each group were evenly divided between the high-average and the average ability levels. All attended the suburban school. The main purpose of the placebo comparison, in view of the significant differences observed between the complete experimental and control groups, was to determine whether the sentence-combining treatment had in fact enhanced normal growth, or whether it had only appeared to do so in comparison with a conventional grammar treatment which actually retarded growth. In other words, the placebo comparison represented an attempt to define the notion of normality in terms of the growth observed in a grammar-free curriculum featuring more literature and more instruction in composition. The effects of the control treatment as well as of the experimental treatment could then be compared with the results of the no-grammar approach.

The initial step was to determine whether there were significant differences on the twelve factors somewhere among the three groups. Table 13 shows the results of analysis of variance on post-test scores, with pre-test scores covaried. Nine of the twelve factors contain significant differences. On all factors except the subordination-coordination ratio, the observed means favor the experimental group. The placebo group added the fewest sentences by coordination, a fact which explains their having the highest apparent subordination-

Table 13

Comparison of Post-Test Mean Scores of the Experimental and Control Sub-Groups and the Placebo Group on the Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried

Factor	Obtained Means			Adjusted Means			F-Ratio
	Exp	Con	Pla	Exp	Con	Pla	
Words	11.66	11.17	11.17	11.59	11.31	11.11	0.95
S/C R	5.77	5.36	5.90	5.84	5.23	5.96	1.13
N Cls	18.18	12.29	14.34	18.16	12.33	14.33	14.59**
N Phs	10.45	6.08	5.95	10.44	6.19	5.85	15.92**
R Cls	30.80	26.10	25.82	30.60	26.59	25.53	5.43**
R Phs	52.79	42.86	50.23	53.23	43.12	49.53	4.95**
R Wds	99.69	84.66	83.37	100.73	83.83	83.16	10.76**
E K S	211.87	171.82	179.64	212.73	171.82	178.77	16.07**
Clu F	25.70	21.80	23.45	25.53	22.05	23.37	2.86
Clu S	2.27	2.18	2.18	2.27	2.18	2.17	7.39**
Emb F	80.90	73.45	73.21	80.97	73.59	73.00	17.85**
Depth	1.54	1.38	1.44	1.53	1.38	1.43	17.76**

DF: 2, 137
F-Ratio required at .05: 3.07
F-Ratio required at .01: 4.77
*significant at or beyond the .05 level
**significant at or beyond the .01 level

coordination ratio and the shortest apparent T-unit length. Note that the subordination-coordination ratio should always be viewed in light of total EKS. Here, for example, although the placebo group has the most attractive proportion of subordinate to coordinate structures, it is actually using fewer subordinate structures per T-unit than is the experimental group. Of the nine significant differences noted, comparisons of the extreme means show that five necessarily favor the experimental group over the placebo group, and four favor the experimentals over the controls. Clearly then, neither the placebo group nor the control group consistently outperformed the other.

The second step in the placebo comparison was to compare the groups two at a time. Table 14 shows the analysis of variance as performed on gains scores on the nine factors which contained significant differences among groups. The change of analytical procedure from the all-groups to the paired comparisons is somewhat unorthodox. Examining gains scores, however, has the advantage of making these scores available for inspection, although it is not so successful in compensating for regression effects as continued use of the covariance analysis would have been. As noted above, the three groups were indistinguishable on the cluster-frequency factor. Although this factor did separate the complete experimental and control groups, it is, of the ten factors pertaining to sentence embedding, perhaps the one least influenced by the experimental treatment. Otherwise, the experimental group is shown on the pair comparisons to have significantly outperformed both of the other groups on all embedding factors, except only that it is indistinguishable from

Table 14

Pair Comparisons of Mean Gains Scores of the Experimental and Control Sub-Groups and the Placebo Group on Nine Factors of Syntactic Fluency

Factor	Gains-Score Means			F-Ratios		
	Exp	Con	Pla	Exp-Con	Exp-Pla	Con-Pla
N Cls	3.56	-0.90	0.07	9.77**	5.69*	0.43
N Phs	3.53	-3.01	0.86	25.10**	4.58*	7.26**
R Cls	6.21	3.92	0.89	1.30	7.49**	2.62
R Phs	19.72	9.43	14.80	8.78**	2.09	2.06
R Wds	31.95	14.39	13.94	15.42**	17.77**	0.01
E K S	64.93	23.67	30.29	26.49**	21.08**	0.64
Clu S	0.10	-0.01	-0.04	6.03*	8.54**	0.42
Emb F	12.09	4.84	3.49	18.49**	22.46**	0.44
Depth	0.18	0.04	0.07	20.60**	10.11**	1.46

DF: 1, 92
F-Ratio required at .05: 3.95
F-Ratio required at .01: 6.93
*significant at or beyond the .05 level
**significant at or beyond the .01 level

the placebo group on relative phrases and from the control group on relative clauses.

More importantly, the only significant difference between the placebo and control groups was that recorded on the noun phrase factor. The pre-test means on this factor for the experimental and control subgroups and the placebo group were 6.9, 9.1, and 5.1 respectively. At post-test the means were 10.4, 6.1, and 6.0. Thus the pre-test performance of the controls, as mentioned earlier, appears to be an anomaly in otherwise quite well-behaved data. It is their falling off from this artificially high initial standing that produces the significant gains-score difference when compared with the placebo group. All of this suggests that there are in fact no meaningful differences between control and placebo, although the trend of the observed means gives a slight edge to the placebo group. In general, two conclusions seem warranted. First, the growth produced by the sentence-combining treatment represents a significant enhancement of normal growth, regardless of whether the latter is defined in a curriculum environment featuring conventional grammar, or in one with no grammar study of any kind. Second, conventional grammar is in fact a kind of placebo treatment itself, in that the effects which it produces do not differ significantly from those observed in a no-grammar environment.

One further point follows from this second conclusion. It will be recalled that earlier in this report the heavy emphasis on error-centered usage practice was cited as the possible cause of the retarded growth of sentence structure implicit in the grammar groups of Harris

(1962) and Milligan (1939). In the present study, the placebo group underwent more usage practice than did the control group, yet their observed performance, statistical tests aside, is if anything slightly better than that of the control group. Thus it may very well be the case that conventional grammar study fails to promote growth of syntactic fluency not because of the usage practice which it features, but rather because of the hundreds of simply-structured and altogether childish sentences which it employs for parsing exercises. As noted, this is the case with conventional textbooks generally, not merely with the one used in this experiment. Nor are the sentences featured in grades eight or nine very much more mature, although they include a wider range of construction types. If true, this observation raises serious doubts as to the manner in which linguistic study is currently being introduced to junior high school students in the vast majority of American schools.

Secondary Observations and Findings

A number of secondary observations may be reported which derive from the separate use of three stratifying variables: sex, pre-test developmental standing, and urban-suburban school. The general goal of these two-way analyses of variance was to determine whether the magnitude of the treatment effect was significantly dependent upon which of the two categories represented in each of the stratifying variables a subject may have belonged to. More simply, was the treatment more effective for boys than for girls, or for girls than for boys, and so forth.

Post-test mean scores of boys and girls, with pre-test scores covaried, are compared in Table 15. Subjects from the highest ability level, all of whom were boys, were omitted from this comparison. Notice that all interaction F's are insignificant and low. Without qualification, then, the experimental treatment proved as effective for students of one sex as of the other. Adjusted means for boys and girls are given for display purposes. These were computed separately in a subsequent one-way analysis, since the available computer program for the two-way did not provide adjusted means. Apparently this procedure makes for less powerful adjustments, but they would have been slight in any case. Both the boy and girl experimentals significantly outperformed their control counterparts on the five main transform types and most of the other factors as well. Notice that the clearly indistinguishable post-test standings of the two experimental sub-groups, compared with the fact that the control boys are observed to stand generally below control girls, does suggest an interaction trend favoring boys, whose normal developmental level at the age in question may in turn be slightly below that of girls. But this is little more than conjecture.

In the next comparison, subjects in the experimental and control group were sorted into two equal sub-groups (50 subjects per sub-group per treatment) according to whether they ranked in the top half or the bottom half of their treatment group on total EKS at pre-test. In other words, the second variable was an indicator of high or low initial developmental level. Mean gains scores were compared in the two-way analysis shown in Table 16. The assumption was that the tendency of

Table 15

Comparison of Post-Test Mean Scores of Boys and Girls in the Experimental and Control Groups on the Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried

Factor	Interaction	Boys' Adjusted Means			Girls' Adjusted Means		
	F-Ratio	Exp	Con	F-Ratio	Exp	Con	F-Ratio
Words	0.98	11.02	9.93	16.19**	10.97	10.31	3.61
S/C R	0.79	5.83	5.08	3.48	5.56	4.33	11.57**
N Cls	0.26	16.86	11.17	26.61**	18.88	14.17	12.60**
N Phs	0.10	9.54	3.81	54.63**	9.26	4.01	45.82**
R Cls	0.02	26.85	22.77	6.24*	26.89	22.43	7.80**
R Phs	1.34	45.33	32.62	15.71**	43.96	36.52	5.64*
R Wds	0.56	86.26	66.19	19.89**	86.27	71.40	9.66**
E K S	0.77	184.29	136.91	35.69**	185.59	148.08	22.07**
Clu F	0.76	21.52	16.78	13.60**	21.80	18.67	3.84
Clu S	1.78	2.23	2.14	6.82*	2.20	2.17	1.31
Emb F	0.06	75.03	65.82	23.71**	77.09	68.45	28.50**
Depth	0.55	1.48	1.30	42.62**	1.49	1.34	31.07**

DF for interaction: 1, 177; for boys: 1, 85; for girls: 1, 91
F-Ratios required at .05: for interaction: 3.90; for boys and girls: 3.95
F-Ratios required at .01: for interaction: 6.78; for boys and girls: 6.94

*significant at or beyond the .05 level
**significant at or beyond the .01 level

Table 16

Mean Gains-Score Interactions of Treatment with Low-High Pre-Test Stratification on the Twelve Factors of Syntactic Fluency

Factor	Exp: Mean Gains		Con: Mean Gains		Interaction
	Low	High	Low	High	F-Ratio
Words	1.19	1.35	0.49	0.02	2.05
S/C R	1.24	1.59	0.65	0.25	1.31
N Cls	4.02	2.77	0.23	-1.58	0.07
N Phs	3.64	4.11	-1.81	-2.99	1.22
R Cls	7.83	4.87	2.07	0.84	0.42
R Phs	13.88	17.62	7.34	1.70	4.16*
R Wds	20.01	26.44	6.30	-0.29	4.28*
E K S	49.61	55.69	14.13	-2.48	4.18*
Clu F	10.86	7.82	3.13	-1.54	0.40
Clu S	6.27	6.66	3.84	1.04	2.16
Emb F	0.05	0.07	-0.02	-0.02	0.06
Depth	0.18	0.16	0.01	-0.01	0.04

DF: 1, 196
F-Ratio required at .05: 3.89
F-Ratio required at .01: 6.76

*significant at or beyond the .05 level

individual subjects in both of the complete treatment groups would be to regress toward the means of their groups from test to test. This in turn would make the gains-score means of the high-half sub-groups lower than those of the low-half sub-groups, even though the mean post-test standings of the complete groups would have risen. The three significant interaction F's together with the general trend of means on eight other factors show that this is exactly what happened among the control subjects. The experimental subjects, however, tended to be uniformly boosted by their treatment, which set the entire group in motion. There is some question whether the significant interactions should be attributed more to the regression tendency of the controls, or more to the offsetting tendency of the experimental treatment to exert its uniformly positive effect to a degree that is proportionate to initial developmental standing, and thus differentially. But it is definitely not compensatory, in the sense that it did not induce significant "catching up" growth on the part of the low-half subjects. A majority of the latter were urban students, and this factor perhaps should have been included in this comparison as a third-dimension variable. In any event, the important fact here is that the sentence-combining practice produced growth regardless of a subject's high-low initial developmental standing.

In the third comparison, the urban-suburban categorization was used as the stratifying variable. It will be recalled that the curriculum tracks represented in the urban schools were the extreme high and low ones, whereas those in the suburban school were middle. In a very rough sense, then, this would tend to make the standings of the two sub-groups equivalent, in that they would average out to middle levels in both schools. No indices of socio-economic status were employed, but the neighborhoods and districts served by the schools resembled those typically associated with lower-middle class status in the case of the urban schools, and upper-middle class status in that of the suburban school. The pre-test developmental differences between the urban and suburban children were quite striking. Table 17 shows the comparison of pre-test standings for the 88 urban subjects, the 94 suburban subjects, and the 18 private school boys. Pair comparisons were not performed, but on the basis of observed means on three relative transforms, for example, it appears that urban students arrive for their junior high school education lagging behind their suburban mates by two full years in clauses, and one year in phrases and words.

Clearly then, it would have been most fortunate had the sentence-combining practice interacted with the urban-suburban variable in a way favorable to the city students. Table 18, however, shows that interaction occurred only on the length of T-unit factor. This disfavored the urban control subjects, half of whom were in the class taught during the second semester by the novice teacher. The decrements observed on the part of many of these subjects may partially have resulted from low motivation at post test, although the extent to which this might have inflated the experimental-control differences is not sufficient to compromise the effectiveness of the experimental treatment. The balance of Table 18 pertains to experimental subjects only. Mean gains scores are presented for inspection, and separate one-way analyses of covariance

Table 17

Comparison of Pre-Test Scores of all Subjects on the Twelve Factors of Syntactic Fluency as Indices of Developmental Levels of Urban, Suburban, and Private School Students

Factor	Pre-Test Means			F-Ratio
	Urban	Suburban	Private	
Words	9.40	10.25	11.20	23.31**
S/C R	4.14	4.46	5.13	2.77
N Cls	13.53	13.91	14.71	0.42
N Phs	3.90	8.00	7.02	22.26**
R Cls	19.10	23.39	25.72	9.64**
R Phs	26.40	33.25	48.28	25.36**
R Wds	60.48	69.00	73.54	7.44**
E K S	123.28	147.55	169.26	22.91**
Clu F	13.19	17.19	22.12	17.79**
Clu S	2.16	2.18	2.23	1.24
Emb F	64.06	68.71	75.06	18.45**
Depth	1.29	1.35	1.41	11.53**

DF: 2, 197

F-Ratio required at .05: 3.04
F-Ratio required at .01: 4.71

**significant at or beyond the .01 level

Table 18

Comparison of Mean Post-Test Scores of Urban and Suburban Students in the Experimental Group only on The Twelve Factors of Syntactic Fluency, with Pre-Test Scores Covaried

Factor	Interaction	Mean Gains		Adjusted Post-Test Means		
	F-Ratio	Urban	Suburban	Urban	Suburban	F-Ratio
Words	7.92**	1.01	1.28	10.72	11.26	2.31
S/C R	3.74	1.23	1.55	5.59	5.79	0.21
N Cls	0.39	3.83	3.56	17.83	18.10	0.04
N Phs	3.78	3.80	3.53	8.31	10.29	6.36*
R Cls	0.82	4.54	6.21	23.49	30.23	19.30**
R Phs	0.00	8.86	19.72	38.18	51.10	17.67**
R Wds	0.35	11.59	31.95	74.54	96.82	30.99**
E K S	0.17	32.81	64.93	166.49	211.87	25.01**
Clu F	3.50	4.27	8.13	19.04	24.71	17.43**
Clu S	0.38	0.01	0.01	2.16	2.27	14.47**
Emb F	2.65	6.41	12.09	71.92	80.48	36.89**
Depth	0.38	0.14	0.18	1.44	1.52	7.33**

Note: The interaction F refers to a two-way experimental-control by urban-suburban analysis. DF: 1, 177; F required at .05: 3.90; F required at .01; 6.78. All other data refer to experimental subjects only.

DF: 1, 88
F-Ratio required at .05: 3.95
F-Ratio required at .01: 6.93

*significant at or beyond the .05 level
**significant at or beyond the .01 level

are shown. The urban subjects experienced growth, but as implied by the absence of interaction effects, this growth neither closed nor widened the gap separating them from the suburbans, even though the poor performance of the urban controls would have made significant gap-closing interaction easier to achieve.

It may be that what appeared to the experimenter to be rather discipline-centered and drill-oriented pedagogy in the urban schools made it more difficult for these subjects to write freely. Or it may be that urban students would start slow but later accelerate faster if exposed to a longer practice period. Finally, while teachers' records showed that all experimental subjects were able to work out the practice problems satisfactorily, the urban subjects experienced more difficulty in doing so than did the suburban ones. Correlations between reading comprehension scores and total post-test EKS were .50 for the urbans and .34 for the suburbans. Thus it may be that the vocabulary of practice problems was graded too far above the urban students and thus reduced the effectiveness of the treatment. All these possibilities should be considered further, since it would be desirable to learn whether the sentence-combining problems, or the school settings in which they might be given, could be altered in such a way that the deficits in syntactic fluency which seem to have accrued to urban schoolchildren would thereby tend to be erased.

Following the above comparisons, an evaluation of overall quality of writing was performed on a small sub-sample (8%) of the total writing produced. Obviously inadequate, the sample size was the largest permitted by available resources. In order to include the placebo group, 35 subjects were selected by random draw from each of the three treatment groups at only the high-average and average ability levels. Two compositions per test were selected for evaluation, topics two and eight (Cf. Appendix C). These were typewritten so that spelling and punctuation errors could be corrected, and author and group identification omitted. Six junior high school teachers, naive as to the nature of the experiment and the test times of compositions, were recruited to evaluate this writing on a five-level scale using the rapid-reading technique employed by the College Entrance Examination Board (Cf. Noyes, 1963). Raters were instructed to base their judgments equally upon the following factors: ideas, organization, style, sentence structure, and vocabulary. Procedures were standardized during an initial practice period. Of the two compositions per subject per test, one was read by three of the raters and the other by the other three raters. The six ratings per subject were then summed. A subject's score at each test time thus could range from 6 (lowest) through 30.

As discussed earlier, it did not seem reasonable to predict that one year's enhanced growth of syntactic fluency, which in the complete experimental group averaged one additional sentence embedding in every two T-units, would be sufficiently notable to influence the overall judgments of raters, who of course were simultaneously attending to four other factors of writing quality in addition to that of sentence structure. On the other hand, the speculation is often heard that "forced" growth of aspects of verbal ability may produce harmful side effects of unspecified kinds. Thus the purpose of the overall-quality comparison was to establish whether the general goodness of writing in the experimental group was significantly different from that of the other groups, and in the event of a negative difference, to determine whether such difference might be attributable to undesirable effects of the sentence-combining problems.

The post-test scores of the three groups were compared by analysis of variance, with pre-test scores covaried. The obtained means of the experimental, control, and placebo sub-groups were 19.80, 21.71, and 18.29, and the adjusted means were 19.29, 21.80, and 18.71, respectively. The F-ratio of 7.17 (DF: 2,101; required at .01: 4.82) was significant at or beyond the .01 level. This difference necessarily favored the control group over the placebo group. Subsequent pair comparisons showed that the standing of the controls was also significantly higher than that of the experimentals, but that the experimental and placebo groups were indistinguishable. Strictly speaking, then, the question raised in the overall-quality comparison was answered ambiguously. The writing of the experimental group was inferior to that of the subjects who had studied conventional grammar, but indistinguishable from that of subjects who had studied no grammar but had received extra instruction in composition -- curious results indeed.

One notes first of all that the raters' judgments appeared to be both consistent and valid. Their inter-rater reliability was .83, and they generally separated pre-test from post-test writing. The latter, as would be expected, received significantly higher average ratings, although negative change scores occurred in all groups. Careful examination of the above writing, particularly that of the five subjects in the experimental group whose large negative change scores accounted for the experimental-control difference, produced no evidence whatever of strained, garbled, or otherwise tortured sentence structure peculiar to the experimental group. Recall that the amount of inter-test composition writing was equal for all groups. In general, then, it would seem that the differences in quality of writing did not follow from the systematic effects of any given variable, except that the highly experienced control teacher may indeed have been a significantly superior composition instructor. In any case, the above findings clearly cannot be interpreted to mean that untoward or vexatious side effects derive from the sentence-combining practice.

One final observation may be made, this concerning the inter-T-unit logical conjunctions listed during the initial syntactic analysis. As discussed above, it was hypothesized and confirmed that sentence-combining practice featuring only nominal and relative embeddings would not affect the incidence of these conjunctions. This was true both of logical conjunctions in general and of the several conjunction types taken separately. If the totals for all treatment groups at each test time are pooled, the following rather broadly based (upwards of 21,000 T-units per test) picture emerges of normal developmental levels for grade seven, given in occurrences per 100 T-units:

Conjunction Type	Pre-Grade 7	Post-Grade 7
Coordinates ("and")	9.0	7.4
Adversatives	4.6	4.7
Causals	2.6	2.7
Conditionals	3.2	3.4
Concessives	0.3	0.4
Others (illatives, purposives, and disjunctives)	0.5	0.6

While the gradual disappearance of the inter-T-unit "and" is quite perceptible, one is struck by the low totals and the negligible growth of the other conjunction types. Clearly, grade seven is too early an age to try to enhance development of aspects of syntactic fluency defined by the use of logical conjunctions, since this development has yet to begin. The exclusion of these words from the sentence-combining problems used in this experiment thus appears to be fully warranted. At the same time, however, an interesting question for future research would be whether the sentence-combining format can be effectively adapted so as to include problems on logical conjunctions for use in grades eight and nine. Various procedures might be tried which would require the student to relate sentences of appropriate content across logical conjunctions in such a way that his concepts as to the entailments of these important words would be maximally strengthened just at the time when he normally begins to use significant numbers of them in his writing.

Conclusions and Implications

There is little to be gained, it would seem, by belaboring the several conclusions expressed earlier in this chapter. The experimental subjects as a group underwent the growth hypothesized for them. This growth was significantly greater than that observed in the control and placebo groups, whose final standings were mutually indistinguishable. No statistically supportable evidence was found to suggest that the magnitude of growth within the experimental group, when compared to that within the control group, was dependent upon whether subjects were boys or girls, or whether they attended urban or suburban schools. While the occurrence of growth was uniform within the experimental group regardless of whether subjects ranked in the upper or lower half of the group on the scale of pre-practice development, it can be argued, although somewhat ambiguously, that the magnitude of this growth was significantly greater for the initially high-half subjects than for those initially in the low half, as compared with growth observed in the high and low halves of the control group.

Insofar as they are matters of record observable in the experiment data, the above statements, where statistically unambiguous, are indisputably factual. They do not, however, indefeasibly validate the conclusion that the extra growth of the experimental group may be unequivocally attributed to the sentence-combining practice. While nothing in the data as interpreted suggests a view of this practice which would vitiate the rationale posed for it earlier, and while the experimenter has already declared for the above conclusion, its acceptance is entirely contingent upon the degree of credibility which one is willing to vest in the several design features of the experiment, particularly since the notorious vicissitudes of human language performance render the findings of research thereon tenuous almost by definition. Note that it was a concern as much for design as for rationale that earlier prompted the close examination of Bateman and Zidonis' signal experiment.

It will have been noted, then, that the general design strategy of the present study was to control what could be controlled, at least ostensibly, (treatment lengths, inter-test composition writing, literature study, ability level of subjects, writing stimuli, absence of coaching, analytical procedures, and so forth) and to average out the effects of what could not be controlled through a recourse to observations of relatively large numbers of things (subjects, classes, teachers, types of school, compositions, types of topic, and of course, T-units). Furthermore, it is impossible to exaggerate the significance contributed to this study by Professor Hunt's findings on the variables and normal parameters of growth of syntactic fluency, or language elaboration. In the final analysis, however, it must be left to the reader himself to determine whether the enhanced growth experienced by the experimental subjects was indeed the direct result of transformational sentence-combining, as well as whether this growth represents a phenomenon which might just as accurately be labeled cognitive development.

It is true, of course, that certain general reservations may be lodged in respect to the efficacy of the sentence-combining practice. A longer-term experiment including a mid-test measure would obviously have been more convincing than the present study. Then too, the final test of these practice routines lies in the examination of writing produced under ordinary and wholly unstructured conditions, doubtless outside the English classroom. Although such a test was not feasible here, it is nonetheless crucial. And as noted previously, the growth brought about by this practice would have to prove itself durable and sustainable over a several-year period, for only then would it accrue to a degree that would be readily apparent in individual selections of writing, and thus evaluable in terms of the broad goals of the English curriculum.

Furthermore, it would be desirable to have information on the incidence of syntax errors in the post-test writing of all groups in the experiment. These would not include cases of obvious oversight or vernacular syntax, but true failures of production in which the student was apparently incapable of well-formedly structuring everything he had intended and attempted to say within a particular independent clause. Many errors of this sort were observed in the writing of all groups, and a systematic tabulation of these is planned for the immediate future. At present, however, it is not known whether there were significantly more or fewer of these errors in the writing of the experimental group. The results of the overall-quality check, although to a certain extent ambiguous, would of course suggest that the experimentals were no more error-prone than were the other subjects. Even if they had been, however, it would be no cause for alarm, although many would not share this view. Despite the preoccupation with error-remediation in the grammar curriculum, (_Cf_. Searles and Carlson, 1960, Meckel, 1963, and Braddock, Lloyd-Jones, and Schoer, 1963, for many studies not mentioned in chapter one) very little creative thinking has been done on the diverse nature and cause of error. In this case, for example, it is quite reasonable to predict that the experimental treatment would be associated with a high incidence of the kind of error mentioned above, since the students were tacitly attempting to say more per statement as a result of the treatment. But these errors would be freak occurrences rather than rule-governed behaviors. In time, as the student's ability to monitor and control mature productions continued to develop, the errors would tend to disappear. In the meantime, then, rather than withhold the sentence-combining practice and inhibit the student's writing by drilling him on anomalies, it would seem preferable to regard even the increased incidence of error as only temporary and hardly deserving of comment. The student would then remain free to pursue in his writing the wholly commendable policy of nothing ventured, nothing gained, and would not be inclined to the stultifying "play it safe" tactics so often apparent in student prose.

But turn now to the question of curricular implications which obtain in the findings of this study. It should be remembered first of all that what each of the sentence-combining "problems" actually represents is one mature sentence entered upon the record of the student's total experience in language. Thus the significance of this research, assuming its findings are borne out in future studies covering a wider range of grade levels, pertains only secondarily to the particular format of the sentence-combining activities it investigates, and hardly at all to the model of grammar in the context of whose study they were presented. Rather, its significance resides in its having demonstrated that systematic programs entailing the a-rhetorical, intensive, and specially structured experiencing of mature sentences, can bring about an increase in the otherwise normal rate at which the sentence structure of the student's own productions becomes more highly differentiated and thus more mature. Subject once again to findings of subsequent studies, it appears further that this increase of growth rate is of sufficient magnitude to justify one's regarding the programs which produce it as valuable supplements to reading, writing, and discussing, which would of course remain the staple activity content of the several subjects in English.

In a way, then, this study has confirmed a belief which the English curriculum, on behalf of its grammar component, has long posited simply as a venerable but nonetheless much-questioned article of faith. The crucial difference is that the conscious application of grammatical learnings, and the conscious imitation of existing sentences, both of which misrepresent the composing process and thus have always been instinctively rejected by students, were specifically enjoined from the rationale and procedure of the present study. In this connection it should be emphasized once again that transformational sentence-combining, as a set of practice activities, falls within the curricular context of studies in linguistics. It is not a program of composition or rhetoric, and would neither replace or supplant such programs nor take over the subject matter for which they are responsible. It is wholly compatible within the English curriculum with all approaches to composition known to the experimenter, except of course those predicated upon the direct applicability of grammar learnings (Ney, 1966, and Raub, 1966, for current examples).

Obviously, however, the above remarks stop far short of advocating the general use of sentence-combining problems at the present time. There is simply too much else that one would wish to learn regarding the effectiveness of such activities. For example, the evidence of the high-low halves, and the achievement of urban students with low initial standings, suggest that the difficulty of the problems in this experiment, whether because of vocabulary or average number of required embeddings, was pitched above that which would have been optimally appropriate for students of lower initial development. At a different level of concern, it remains to be determined exactly when the effects of enhanced syntactic fluency would begin to be reflected in judgmental responses of the general reader, and whether the motivational attraction of the sentence-combining problems can be maintained over several years of use, even though the problems during a multi-year program would range over sentence and conjunction types not included in the present study.

Furthermore, it is possibly the case that the greatest dividends from these problems are to be obtained through using them in the elementary grades rather than in junior high school. Notice that the only "grammar" actually required is a list of names for the string transformations. These names may be chosen at will. The only other necessary learnings pertain to the tokens involved in the rewritings, and the details of format. Somewhat less complex problems could thus be solved by fourth, fifth, and sixth graders as a kind of language-building game not at all contingent upon grammar study in the ordinary sense. At the opposite extreme, high school teachers might incorporate certain forms of these problems into their composition programs, where they would be given in company with various kinds of discrimination training designed to school the student in the conscious employment of particular rhetorical turns and devices. Then too, it is reasonable to believe that sentence-combining practice could also serve as a vehicle for vocabulary learning, and that it may contribute to the development of reading ability. All of these putative benefits and potential uses deserve study.

Finally, there may of course be some who will wish to cite the foregoing experiment as proof that grammar study should remain a component subject in English. In reality, the experiment proves nothing of the kind, nor was it intended to. In the writer's view, the question whether secondary school students should be required to pursue the study of linguistic structure and mores has never been at issue, either in this experiment or generally. The crucial matter, in linguistic studies as in any other school subject, is that presented content must be interesting and intellectually satisfying. Obviously, the surest way to destroy the integrity of subject matter is to advertise its value as an instrumentality to some immediate goal not integral to the subject itself. Tendencies in this direction have plagued conventional school grammar from its beginnings. They reached a high point in the functional grammar movement, and may be seen today in frivolous attempts to popularize structural and transformational grammars as novel approaches to composition. Thus it would be a disservice to the potentiality of both modern school linguistics and the sentence-combining notion to justify and shape the former as nothing more than an otherwise meaningless vehicle for the latter.

APPENDIX A

PRECIS OF THE STUDENTS' GRAMMAR TEXT

In the current debate on how best to introduce junior high school children to the study of linguistic structure, several approaches are advocated. One of these argues that the most important factor to be considered is the theoretical status of presented content. Here just the latest and most explicit formulations are given in what is essentially a straightforward deductive manner, as if mere comprehension of content were the ultimate goal of the student's endeavors, and as if the given formulations were not soon to be supplanted by newer findings even as they themselves have only recently replaced older ones. Another approach argues that content, regardless of its status, should not be presented in a systematic deductive manner, since it is the quality of the reasoning and discovery experience, not the understanding of content, that is said to be crucial. A weak form of this approach presents specially arranged data and questions, and aims through a process of quasi-induction to lead the student to "re-invent" existing formulations. The stronger form advocates encounters with unplanned problems, presumably without known solutions, which would arise spontaneously during teacher-pupil dialogue. The latter rests on the somewhat optimistic assumption that naive students inexperienced in prior linguistic study will be able to theorize non-trivially, in much the same way that linguists conversant with the goals and existing formulations of their discipline attain novel insights in the privacy of their studies.

Obviously, the many aspects of this problem cannot be discussed at length in this report. In the present writer's view, however, neither of the above approaches is desirable for introductory studies in grades seven and eight. It seems preferable to acquaint students of this age with a grammar high on the scale measuring range of sentences described, but low on the scales measuring degree of explicitness and recency of formulation. Although the teaching could proceed on the quasi-inductive model already mentioned, content would be introduced systematically and would cover the full range of construction types included in reasonably thorough traditional grammars. The descriptive principles would appear outwardly as phrase structure and transformation rules, but would lack the explicitness required for an exact extensional accounting of the sentences ostensibly under description. Nonetheless, the student would come to understand the overall character of a generative syntax, recognizing its role as a mediator of sound and meaning systems, and noting that its purpose is to specify structural descriptions for all and only the sentences of the language. Such an approach would avoid the initially confusing abstractness of current formulations in which, for example, auxiliaries and determiners vanish into features, and ghost terms appear in phrase structure rules to facilitate deep-to-surface remapping. Furthermore, subsequent discovery-oriented programs in the high school grades could then invite students to theorize exactly as linguists do, on the basis not only of raw language data but also of a prior knowledge of previously given but inadequate formulations acting as a kind of secondary data pool. In this way, students would recognize that the principal task of the linguist as of any scientist is to reformulate and thus increase the descriptive power of existing theories.

Adventitiously, this approach would also permit activities like the sentence-combining problems investigated above, and would make available throughout the student's high school composition program the full range of traditional but still quite standard grammatical nomenclature.

The student text written for the present experiment was designed in accordance with this approach. Its organizing theme concerns the problem of formulating "instructions" which would characterize the unconscious knowledge by means of which speakers order their words into sentences rather than random strings. This theme is represented in the figure of one "Charlie the Robot," who possesses the words of English, that is, their sounds and meanings, but lacks a sentence-forming system. Phrase structure description of "basic sentences" stops short of differentiating verb classes or auxiliary and determiner types. Phrase structure rules are written in normal English words rather than abbreviational symbols ("consist of" is used instead of the re-write arrow, for example), although term names are sometimes abbreviated ("NP" for."noun phrase"). The diagramming convention used is the now familiar hierarchial "tree." Transformations are shown simply as string permutations, and surface trees are not drawn. The embedding transformations cover nominal and relative forms only, although they operate within recurring "S" structures rather than on the so-called "double base" model. The text is designed to be followed by an eighth grade book which would examine the conjoining and predicate complement transformations, and would present relational terminology and further develop the grade seven phrase structure rules.

The textbook itself is titled Our Sentences and Their Grammar. It contains 162 pages of text and exercises, and is printed in an 8½ by 11 inch "consumable" workbook format with provisions for the student to write all required exercises directly on the pages of the text. Loose-leaf binding was used, and lessons were distributed individually to students. Completed lessons were placed in ring binders kept in the classroom, thus making it possible for the teachers to maintain an accurate check on student progress. The text begins with a preview lesson followed by three units. Unit one consists of five lessons, unit two of four, and unit three of nine. The text ends with a lesson which suggests problems to be dealt with in grade eight. Following is a summary of the lesson by lesson content of this text.

"A Preview Lesson"

notions: language as man's species specific; words and sentences as two objects of language study; basic sentences and transformed sentences.

exercises: discussion questions illustrating role of syntax as an aspect of a speaker's language competence.

Unit One: "The Formation of Basic Sentences"

Lesson One: "Putting Words into Sentences"

notions: knowing a language means knowing its words and its sentences; system for sentences called a grammar; knowledge of grammar is unconscious; Charlie-the-Robot analogy introduced.

exercises: grammatical and non-grammatical word strings;

fragmentary and complete sentences; nonsense words in grammatical and non-grammatical sentences.

Lesson Two: "Constructing a Grammar for Sentences"

notions: limitlessness of possible sentences; grammar constructed as a limited set of instructions for producing sentences step by step; first instruction tells what "sentences" consist of.

terms: sentence, nominal phrase, predicate phrase.

exercises: combining phrases to produce sentences; separating sentences into constituent phrases.

Lesson Three: "The Phrases of Basic Sentences"

notions: nominal and predicate phrases formed of word-phrase constituents; instructions describing these word phrases.

terms: noun, verb, and adjective phrases; nouns, verbe, and adjectives; determiners, auxiliaries, and qualifiers.

exercises: identifying noun, verb, and adjective phrases and their constituend words; tree diagramming; modal, perfect, and progressive auxiliaries.

Lesson Four: "Forming the Basic Sentences"

notions: instructions expanding nominal phrases and predicate phrases; predicate phrase instruction represents three possible expansions; grammars as lists of instructions; tree diagrams show how structures of particular sentences are recognized.

exercises: tree diagrams of basic sentences; abbreviating items in the instructions; transitive, intransitive, and linking verbs.

Lesson Five: "Adverbials in Basic Sentences"

notions: phrases of time, place, and manner optionally included in basic sentences; instructions for these phrases.

terms: time, place, and manner adverbials; prepositions; LY syllable on adjectives.

exercises: identifying adverbials; tree diagrams of basic sentences with adverbials; differentiating basic from non-basic sentences.

Unit Two: "Simple Transformations"

Lesson One: "The Family of Basic Sentences"

notions: the incompleteness of instructions thus far written; alternate forms of basic sentences; a family of forms; transformation as a process for altering sentence form; instructions for these alterations to be called transformation rules.

terms: YES sentence, NO sentence, YES/NO question, WH-question, passive inversion, THERE inversion.

exercises: identifying types of transformed sentences; changing transformed sentences to untransformed ones.

Lesson Two: "Forming YES/NO Questions"

notions: two forms of questions; production of YES/NO questions described in terms of rearranged structures of untransformed basic sentences.

terms: YES/NO question T rule; DO auxiliary.

exercises: forming YES/NO questions; writing a similar T rule for NO (negative)sentences.

Lesson Three: "Forming WH-Questions"

notions: WH-questions formed from sentences from which information has been omitted lexically but is spoken of grammatically; SOME-words as filler forms for missing information; WH-words as corresponding question forms.

terms: WH-question T rule, including YES/NO T rule.

exercises: three-step formation of WH-questions; identification of multiply transformed basic sentences.

Lesson Four: "Forming Sentence Inversions"

notions: synonymity of passive and THERE inversions with their untransformed counterparts; introduction of sentence elements by transformations.

terms: T rule for passive and THERE inversions.

exercises: forming inversions; multiply transforming basic sentences; review discussion of form and purposes of grammars.

Unit Three: "Complex Transformation"

Lesson One: "Complex Transformation: Sentences Within Sentences"

notions: sentences as constituents of sentences; instructions introducing recurring sentences; transformation of recurring sentences.

terms: complex sentence; complex transformation.

exercises: identifying basic and complex sentences; differentiating phrase from sentential constituents; diagramming embedded sentences.

Lesson Two: "Sentences as Nouns: Fact Clauses"

notions: full statements as facts in nominal positions; main-clause sentence and insert sentence; introduction of fact-clause words.

terms: fact clause T rule.

exercises: sentence-combining problems with fact clauses; expletive IT inversion; multiple and recursive embedding.

Lesson Three: "Sentences as Nouns: Question Clauses"

notions: implied questions as clauses in nominal positions; use of WH-transformation and WH-words.

terms: question clause T rule.

exercises: sentence-combining problems; additional WH-words; WH-infinitive phrases as reduced question clauses; cumulative problems.

Lesson Four: "Sentences as Nouns: Gerund and Infinitive Phrases"

notions: occurrences and actions as phrases in nominal positions; alternate forms of object-less gerund phrases.

terms: gerund phrase and infinitive phrase T rules.

exercises: sentence-combining problems; genitive forms of personal pronouns in gerund phrases; cumulative problems.

Lesson Five: "Sentences as Nouns: Derived-Noun Phrases"

notions: sentences abstracted as derived-noun phrases; variety of derivational affixation; alternate forms of phrases.

terms: derived-noun phrase T rule.

exercises: sentence-combining problems; derivational affixes; cumulative problems.

Lesson Six: "Sentences as Noun Modifiers"

notions: sentences embedded as secondary, or modifying, statements following nouns in main-clause sentences; use of WH-transformation; addition of "S" term to NP instruction.

terms: relative clause T rule.

exercises: reciprocal embedding of pairs of sentences containing the same noun; sentence-combining problems; cumulative problems.

Lesson Seven: "Sentences as Noun Modifiers: Modifying Phrases"

notions: reduction of relative clauses with WH-word as subject plus form of BE.

terms: participle phrase, passive participle phrase, infinitive phrase, passive infinitive phrase, preposition phrase, appositive phrase.

exercises: deletion of WH-word plus BE; sentence-combining problems; cumulative problems.

Lesson Eight: "Sentences as Noun Modifiers: Pre-Noun Modifiers:

notions: reduction of relative clauses and pre-noun positioning of remaining element.

terms: adjective phrase, participle, passive participle, participial compound.

exercises: deletion of WH-word plus BE and pre-positioning of remainder; sentence-combining problems; cumulative problems.

Lesson Nine: "Building Noun Modification"

notions: multiple, or parallel, modification of single nouns by two or more relative clauses or their reductions.

exercises: cumulative sentence-combining problems.

"Constructing a 'Complete' Grammar"

notions: problems of "completing" a grammar; phonology and lexicology; illustrations of basic and transformed sentences remaining undescribed by formulations given earlier in the text.

exercises: differentiating described from undescribed sentences; cumulative sentence-combining problems.

APPENDIX B

SAMPLE SENTENCE-COMBINING PROBLEMS

In each of the following illustrations, the A form is the sentence-combining problem as presented, and the B form represents a correct student response. The labeled examples given initially illustrate particular transform types from the full roster of transformations examined by the students. The remaining illustrations are included as random examples of multiple-embedding problems.

Fact Clause:

A. SOMETHING seemed to suggest SOMETHING.
Bill finished his lessons in less than an hour. (T:fact)
He had received special help from another student. (T:fact)

B. The fact that Bill finished his lessons in less than an hour seemed to suggest that he had received special help from another student.

Question Clause:

A. In her letter Mrs. Browning demonstrates SOMETHING.
So much feeling may be conveyed by a few sords. (T:wh)

B. In her letter Mrs. Browning demonstrates how much feeling may be conveyed by a few words.

WH-Infinitive Phrase:

A. The instruction manual did not say SOMETHING.
Someone overhauls the engine sometime. (T:wh+inf)

B. The instruction manual did not say when to overhaul the engine.

Infinitive Phrase:

A. SOMETHING would be almost unbearable.
The rocket fails in its final stage. (T:infin)

B. For the rocket to fail in its final stage would be almost unbearable.

Gerund Phrase:

A. SOMETHING caused howls of laughter from the audience.
    Paul accidentally dropped the curtain during SOMETHING. (T:gerund)
        Charlie read the Gettysburg Address. (T:gerund+of)

B. Paul's accidentally dropping the curtain during Charlie's reading of the Gettysburg Address caused howls of laughter from the audience.

Derived-Noun Phrase:

A. SOMETHING will very likely hinder SOMETHING.
    Those trawlers are closely concentrated. (T:der-NP, alternate)
    We speedily recover the astronauts. (T:der-NP)

B. The close concentration of those trawlers will very likely hinder our speedy recovery of the astronauts.

Relative Clause:

A. Officer Hermes ambled over toward the automobile.
    Officer Hermes only wanted a light for his pipe.
    He had flagged the automobile down out of the traffic lane.

B. Officer Hermes, who only wanted a light for his pipe, ambled over toward the automobile which he had flagged down out of the traffic lane.

Reduced Relative Clauses:

A. A volume of poetry lay unguarded near the library exit.
    The volume was thin.
    The volume was brown.
    The volume was leather-bound.
    The volume was compiled by Dr. Johnson
    The volume was a rare first edition.

B. A thin brown leather-bound volume of poetry compiled by Dr. Johnson, a rare first edition, lay unguarded near the library exit.

General Problems:

A. SOMETHING meant SOMETHING.
    The boy realized SOMETHING. (T:der-NP)
        He would have to find a dog. (T:fact)
            The dog would be courageous enough to bay the bear.
    He would have to look beyond the hounds. (T:fact)
        The hounds were loyal but ordinary.
        The hounds were living on the Major's plantation.

B. The boy's realization that he would have to find a dog courageous enough to bay the bear meant that he would have to look beyond the loyal but ordinary hounds living on the Major's plantation.

A. SOMETHING used to anger Grandfather no end. (T:exp)
    SOMETHING should be so easy. (T:fact - T:exp)
        The children recognized SOMETHING. (T:infin)
            SOMETHING was only a preliminary to SOMETHING sometime. (T:wh)
                He insisted SOMETHING. (T:gerund)
                    They had had enough peppermints. (T:fact)
                He gave them still another handful. (T:gerund;

B. It used to anger Grandfather no end that it should be so easy for the children to recognize when his insisting that they had had enough peppermints was only a preliminary to his giving them still another handful.

A. A grammar should establish principles.
    The principles apply to all languages.
    The principles reflect the basic properties of the human mind.
        (and)
    The principles would explain SOMETHING and SOMETHING.
        Language is used somehow. (T:wh)
        Language has those unique properties for-some-reason. (T:wh)
            People usually restrict their attention to properties.
                People are concerned with language differences.

B. A grammar should establish principles which apply to all languages, which reflect the basic properties of the human mind, and which would explain how language is used and why language has those unique properties to which people concerned with language differences usually restrict their attention.

A. SOMETHING is to learn SOMETHING.
    A person reads this man's biography. (T:infin)
    The secret of Thomas More is a kind of personality. (T:fact)
        Thomas More's deeds have caused so much controversy.
        The personality arises from SOMETHING.
            He unfailingly expressed a life of prayer. (T:der-NP)
                The life of prayer was specific.
                The life of prayer was exemplary.
                The life of prayer was relative to all his actions.

B. For a person to read this man's biography is to learn that the secret of Thomas More, whose deeds have caused so much controversy, is a kind of personality which arises from his unfailing expression of a specific, exemplary life of prayer relative to all his actions.

A. The lightning revealed SOMETHING.
    The lightning was forking intermittently from clouds.
        The clouds were observable only during its flashes.
    The natives were beginning to run toward the shelter of SOMETHING. (T:fact)
        The natives were on the path ahead.
        The natives had been plodding along in a ragged column.
        Something appeared to be a grove of trees. (T:wh)
            A grove of trees is a resting place in such a storm.
                The resting place is dangerous.

B. The lightning forking intermittently from clouds observable only during its flashes revealed that the natives on the path ahead, who had been plodding along in a ragged column, were beginning to run toward the shelter of what appeared to be a grove of trees, a dangerous resting place in such a storm.

A. The office building towered above the tenements.
    The building was gleaming.
    The building was new.
    The building was rising high into the sky.
    The tenements were decrepit.
    The tenements were brick.
    The tenements were in the slums.
        The slums were surrounding this symbol of prosperity.
            The prosperity was supposedly universal.
            The prosperity was American.

B. The gleaming new office building rising high into the sky towered above the decrepit brick tenements in the slums surrounding this symbol of supposedly universal American prosperity.

A. SOMETHING results from SOMETHING.

The first stages of a war usually fail to dramatize SOMETHING. (T:fact)

People truly think something about mass slaughter. (T:wh)

The initial miseries fall upon soldiers and upon draftees. (T:fact)

The soldiers are hardened.

The soldiers are professional.

The draftees are young.

The draftees are inarticulate.

The draftees cannot readily make SOMETHING known.

They bitterly hate them. (T:der-NP)

B. The fact that the first stages of a war usually fail to dramatize what people truly think about mass slaughter results from the fact that the initial miseries fall upon hardened professional soldiers and upon young inarticulate draftees who cannot readily make their bitter hatred of them known.

APPENDIX C

PRE-POST COMPOSITION TOPICS

All topic sheets were headed as follows:

ENGLISH COMPOSITION
Diagnostic and Achievement Measurement
Grade Seven -- School Year 1965-66

The following is the practice topic written by all students prior to the first pre-test topic. It was not repeated prior to the post-test, nor was it counted in the writing sample. The nine pairs of parallel topics appear on subsequent pages of this appendix.

Topic Number = Practice

A biography, as you know, is the story of a person's entire life, usually written by some other person. An autobiography is a biography of a person's life written by that person himself. Your assignment in this composition is to write your own autobiography in a single paragraph. Here are some ideas that may help you decide what things to tell about:

when you were born, and where
where you've lived, places you've been
important things you've done, memorable experiences you've had
your likes and dislikes: hobbies, sports, entertainment, people
your goals, plans, and hopes for the future
anything else of interest

Instructions:
Plan your autobiography carefully before you write. Use the back of this topic sheet to list your ideas and to try out some of your sentences. But write your final copy on the special lined writing paper. Check your work for spelling and punctuation. Try to write as clearly and interestingly as you can.

Length:
Depending upon the ideas you choose to express, your composition will be anywhere from six or eight to twelve or fifteen sentences in length.

Time:
You may write until the end of the class period. Your teacher will tell you when the period is about to end so that you can finish your work before the class bell.

Topic Number = 10-A

Biographies tell where a person was born, where he grew up, what he did in life, and when he died. But the little things that happen to you sometimes make more interesting stories. This is especially true when you tell about things that were the "most" something or the "first time" for something. Choose one of the following "mosts" or "first times" and write a true story about it. Be sure to say when and where it happened, what you were doing at the time, what actually took place, and how you felt about it afterward.

your most unlucky day
your most frightening moment
your proudest moment
your hardest job accomplished

your first time working at a real job
your first time being away overnight
your first time flying in a plane
your first time getting into a fight or bad quarrel

(Remember: Put your practice sentences on the back of this paper, and write your final copy on the lined writing paper. Plan to finish by the end of class. Be as neat and accurate in your work as you possibly can. And make your story interesting to read.)

Topic Number = 1-B

Biographies tell only the general things about a person's life, such as where he was born, where he grew up, what he did in life, and when he died. But the "little things" that happen to people often make more interesting stories. This is especially true when you tell about things that were the "most" something or the "first time" for something. Choose one of the following "mosts" or "first times" and write a true story about it. Be sure to say when and where it happened, what you were doing at the time, what actually occurred, and how you felt about it afterward.

your luckiest day
your narrowest escape
your greatest thrill
your most embarrassing moment

your first time being on a date
your first time winning a contest or a prize
your first time in the Principal's office
your first time being lost

(Remember: Put your practice sentences on the back of this paper, and write your final copy on the lined writing paper. Plan to finish by the end of class. Be as neat and accurate in your work as you possibly can. And make your story interesting to read.)

Topic Number = 20-A

Did you know that words can be used to paint pictures? They can be, and they can also be made to convey sounds, smells, tastes, and things that you feel. When you describe a scene, you try to make words tell what the things you see are doing and what they look like. You also try to say what they sound like, and how they smell or taste, and how they feel. Now here are some scenes. Select one of them, and imagine that you can see it in your mind's eye. Think about it very carefully! Then write a description of it so that your reader can see what you see, and perhaps also hear, taste, smell, and feel what you do.

waiting in the kitchen while Mother fixes a hot breakfast
lying on the seashore on the hottest day in August
walking the downtown streets the day before Christmas
attending a birthday party
standing near a school playground at recess time

Topic Number = 2-B

Good writers can use words to paint pictures. Not only that, they can use words to convey sounds, smells, tastes, and things that you feel. When you describe a scene, you try to make words tell what the things you see are doing and what they look like. You also try to say what they sound like, and how they smell or taste, and how they feel. Now here are some scenes. Select one of them, and imagine that you can see it in your mind's eye. Think about it very carefully! Then write a description of it so that your reader can see what you see, and perhaps also hear, smell, taste, and feel what you do.

burning leaves on a Saturday in October
watching a hockey game at the Boston Garden
Christmas morning in the livingroom after the presents
walking in a sudden rain on a hot July day
waiting in a bus or a plane terminal

Topic Number = 30-A

A man like Daniel Boone was an expert on transportation in his day. He knew all about horses, coaches, canal boats, and ships -- and mostly his feet. Pretend that a time machine is bringing Daniel Boone back to visit the modern age. Your task is to bring him up to date on developments in transportation since his time. Write a report that you could give him, telling him about several means of transportation that have been invented between his day and our own. Tell him how they work, what they can do, where they go -- everything you think he would want to know.

Topic Number = 3-B

A man like Benjamin Franklin was an expert on gadgets and appliances for the home in his day. He even invented a few new appliances himself, such as the famous Franklin stove. Pretend that a time machine is bringing Benjamin Franklin back to visit the modern age. Your task is to bring him up to date on developments in home since his time. Write a report that you could give him, telling about several home appliances and gadgets that have been invented between his day and our own. Tell him how they work and what they can do -- and everything else about them that you think he might want to know about.

Topic Number = 40-A

Sometimes fiction, or "make-believe," stories are more interesting than true ones. This is especially so when you can make up a story that keeps your reader guessing until the end, that is unusual, but that is perfectly believable. Now here are several titles. Pick the one that interests you most, and then set your mind and imagination to work. Your job is to make up a story to go with the title! You'll have to plan it through carefully. Use your ingenuity, and be sure to tell the full story that you make up. Make it unusual and strange, but also make it believable.

What a Ridiculous Place to be Lost!
There it was -- Standing Right in the Front Yard
A Vacation There was Supposed to be Dull
Never Start a Private Club!

Topic Number = 4-B

Often fiction, or "make-believe," stories are more interesting than true ones. This is especially so when you can make up a story that keeps your reader guessing until the end, that is unusual, but that is perfectly believable. Now here are several titles. Pick the one that interests you most, and then set your mind and imagination to work. Your job is to make up a story to go with the title! You'll have to plan it through carefully. Use your ingenuity, and be sure to tell the full story that you make up. Make it unusual and strange, but also make it believable.

Babysitting Easy? Not Much . . .
Not Even Science can Explain It
First There was this Green Mist
It Looked like such a Tame Creature

Topic Number = 50-A

One of the reasons that man has risen so far above the animals is that he has learned how to tell his fellow men about skills and abilities he has acquired. It is very important to be able to tell someone else how to do something -- even ordinary things. From the following list, select one skill that you know something about. Then write an essay in which you tell someone how to do it. Tell what he needs to know, what materials he needs to have, and the steps he follows.

how to play winning tennis
how to make a dress
how to repair a bicycle tire
how to do ballet or modern dance
how to build up a good model airplane collection
how to amuse younger brothers and sisters

Topic Number = 5-B

One of the reasons that man has risen so far above the animals is that he has learned how to tell his fellow men about skills and abilities he has acquired. It is very important to be able to tell someone how to do something -- even ordinary things. From the following list, select one skill that you know something about. Then write an essay in which you tell someone how to do it. Tell what he needs to know, what materials he needs to have, and the steps he follows.

how to win in sailboat racing
how to prepare your favorite food
how to cook out-of-doors
how to hold a slumber party
how to judge the best automobile
how to entertain Grandmother or Grandfather

Topic Number = 60-A

Perhaps you know someone your own age who lives in a foreign country, or maybe you have a friend who knows such a person. Even if you don't, you can imagine that most young people in other countries who have never visited the United States are extremely interested in our ordinary, every-day way of life.

In this composition, you are to pretend that you know a person in a European country and are writing him (or her) a letter. Your composition is to be one paragraph from that letter, in which you tell your make-believe friend everything that happens during a normal day in your school. Describe whatever you feel might interest him about a day in school -- what classes you have, how they are taught, what the other activities are, the rules and privileges, and so on. Try to mention things that you think are "special" about American schools -- things that might seem strange to a foreigner.

Topic Number = 6-B

Perhaps you know someone your own age who lives in a foreign country, or maybe you have a friend who knows such a person. Even if you don't, you can imagine that most young people in other countries who have never visited the United States are extremely interested in our ordinary, every-day way of life.

In this composition, you are to pretend that you know a person in a European country and are writing him (or her) a letter. Your composition is to be one paragraph from that letter, in which you tell your make-believe friend all about the kinds of things that normally happen on Saturdays during the school year -- your vacation day. Describe everything that might interest him about the typical things you do on Saturdays -- the places you often go, the jobs you have to do, or the projects you plan. Try to describe activities that you think might be of special interest to a foreigner.

Topic Number = 70-A

Everybody uses "old sayings" all the time, but we seldom stop to think what they really mean or how useful they really are. Think about the following sayings, choose one of them, and write a short discussion about it. You will want to accomplish several things in your discussion. You should tell what the saying means as fully as you can. Give some illustrations of times when it could be used. Think of some times when it would not be appropriate advice. Perhaps you will see that some sayings seem to state something that is exactly the opposite of the meaning of another saying.

An idle brain is the devil's workshop.

A stitch in time saves nine.

People who live in glass houses shouldn't throw stones.

He who hesitates is lost.

Fools rush in where angels fear to tread.

Topic Number = 7-B

Everybody uses "old sayings" all the time, but we seldom stop to think what they really mean or how useful they really are. Think about the following sayings, choose one of them, and write a short discussion about it. You will want to accomplish several things in your discussion. You should tell what the saying means as fully as you can. Give some illustrations of times when it could be used. Think of some times when it would not be appropriate advice. Perhaps you will see that some sayings seem to state something that is the exact opposite of the meaning of another saying.

Laugh and the world laughs with you; cry and you cry alone.

A bird in the hand is worth two in the bush.

A chain is no stronger than its weakest link.

Absence makes the heart grow fonder.

Out of sight, out of mind.

Topic Number = 80-A

The most interesting things in the world are the people in it, especially when these people impress you in special ways. Think about all the people in your family other than your parents -- your cousins, aunts, uncles, grandparents, great grandparents, and so forth. Select the one who you have always felt is "special," who impresses you in a certain way. Then write a description showing this person in action and telling the things that are special about him (or her). These things may be the way he looks, or talks and acts, or what he believes and says, or a combination of these things. Above all, try to make your reader see this person as you do.

Topic Number = 8-B

The most interesting things in the world are the people in it, especially when these people impress you in special ways. Think about all the people you know outside of your family and relatives -- friends, teachers, neighbors, Scout leaders, priests or ministers, policemen, and so forth. Select one of these who has always seemed to you to be a "special" kind of person, one who always impresses you in a certain way. Then write a description showing this person in action and telling the things that are special about him (or her). These things may be the way he looks, talks, or acts, or what he believes and says, or a combination of these things. Above all, try to make your reader see this person as you do.

Topic Number = 90-A

Have you ever thought about how often we find ourselves trying to convince other people that they should do or believe a certain thing? We usually try to present all the good reasons for their doing it that we can. And we try to show that the reasons against doing it are not good. Now select one of the following situations, and write an essay in which you try to convince the person named that he should do what you want him to do. Think of all the reasons that you can, and be as persuasive as possible in convincing him that they are good reasons.

Convince your parents that you can select your own clothes styles.

Convince your parents to raise your allowance by a certain amount.

Convince a friend to invite a certain other person to a party.

Convince a teacher that you weren't able to start a home lesson.

Convince a friend to enter a certain extra-curricular activity with you in school.

Topic Number = 9-B

Have you ever thought about how often we find ourselves trying to convince other people that they should do or believe a certain thing? We usually try to present all the good reasons for their doing it that we can. And we try to show that the reasons against doing it are not good. Now select one of the following situations, and write an essay in which you try to convince the person named that he should do what you want him to do. Think of all the reasons that you can, and be as persuasive as possible in convincing him that they are good reasons.

Convince your parents that you should be able to select your own TV programs.

Convince your parents to allow you to take on a certain job outside your home after school.

Convince a friend to patch up a quarrel with another person.

Convince a clerk to lower the price of a second-hand radio.

Convince a friend to go with you and your family on a certain vacation.

APPENDIX D

GAINS SCORES FOR ALL SUBJECTS

Table 1 lists the pre-post gains scores for all subjects in the three treatment groups on ten factors of syntactic fluency. The first two columns identify each subject as to ability level and sex. The following columns show the gains scores of that subject on the ten factors. Numbers in all but two of the columns have been chopped (not rounded) at the decimal. This fact explains the failure of the EKS entry to be exactly equal to the total of the entries in the next five columns.

Table 2 lists in rank order the distributions of scores on ten factors of syntactic fluency. Frequency distributions and gains-score curves for the three groups can be derived from this table, and verificational statistical tests may be performed comparing measures of central tendency across groups. The columns in this table are to be read downward only, since the scores across rows belong to different subjects.

Explanation of Table Headings

L: ability level; 1 is highest, 5 lowest

S: sex; 1 for boys, 2 for girls

EKS: embedded kernel sentences per 100 T-units

NCls: nominal clauses per 100 T-units

NPhs: nominal phrases per 100 T-units

RCls: relative clauses per 100 T-units

RPhs: relative phrases per 100 T-units

RWds: relative words per 100 T-units

CluF: cluster frequency per 100 T-units

ClusS: mean maximum cluster size

EmbF: embedding frequency per 100 T-units

Depth: mean maximum depth of embedding

Table 1, Page 1:

Per-Subject Gains Scores, Experimental Group (read across)

L	S	EKS	NCLs	NPhs	RCls	RPHs	RWds	CluF	ClusS	EmbF	Depth
5	2	-52	-9	-0	5	-17	-26	-9	0.20	-25	-0.12
5	1	-31	-8	2	5	-9	-21	0	-0.28	-10	-0.12
1	1	-28	1	-2	-8	-4	-14	-14	0.00	-8	0.14
5	1	-14	10	2	-16	-15	3	-6	-0.02	-14	-0.06
5	1	-2	10	3	7	-15	-7	-1	0.00	-14	0.10
4	2	-1	-3	3	-17	10	6	-7	-0.22	12	0.06
5	2	1	3	0	3	8	-14	4	-0.02	7	0.14
3	2	1	2	-6	-6	2	9	10	-0.20	1	0.02
3	1	4	2	-5	-4	-3	15	-3	-0.20	12	0.05
4	2	7	2	5	-10	13	-3	0	0.00	-8	0.04
4	2	10	-4	4	-6	13	3	-4	0.16	8	-0.01
4	1	11	-3	4	2	12	-4	1	0.00	-5	0.26
5	1	11	1	11	8	6	-16	2	0.07	-2	0.11
5	1	11	2	8	1	-2	0	0	-0.13	-1	0.19
3	2	16	2	-6	-8	30	0	1	0.30	-2	0.18
4	1	17	11	6	16	-6	-10	-4	-0.21	-0	0.14
4	2	23	5	0	8	6	2	-2	-0.14	15	0.09
1	1	25	3	3	16	8	-6	-1	0.10	3	-0.11
5	1	26	12	5	3	-7	13	6	0.00	0	0.12
2	1	27	-7	3	-6	25	13	8	0.13	6	-0.01
3	2	27	3	2	0	23	-1	5	-0.14	11	0.01
5	2	28	-4	-1	5	6	22	4	0.00	5	-0.01
4	1	28	6	5	2	11	3	5	-0.13	-1	0.32
5	2	28	3	-1	2	-1	25	1	0.19	5	0.07
2	1	29	1	8	-7	12	13	-3	0.13	8	0.17
3	2	29	3	3	10	2	11	7	0.04	14	0.11
4	1	29	7	2	-4	14	10	2	0.05	15	0.13
5	1	31	2	1	12	3	12	2	-0.14	8	0.07
5	2	31	12	3	12	-12	15	6	-0.06	4	0.17
2	1	32	3	4	11	-2	15	1	0.04	0	0.15
2	2	33	4	5	5	13	4	17	-0.37	7	0.17
4	2	33	14	7	0	5	5	2	0.09	17	0.01
4	1	34	-6	3	0	9	32	8	0.09	7	-0.05
5	2	35	12	-0	11	6	5	11	0.06	17	-0.05
4	2	35	0	1	-2	35	1	6	0.14	8	0.20
3	1	36	5	3	4	3	20	5	-0.25	12	-0.03
3	2	37	11	4	7	3	11	4	-0.03	12	0.04
5	1	37	20	3	5	8	0	2	-0.25	4	0.27
2	2	38	-16	2	8	12	32	11	0.11	7	0.17
4	2	38	1	4	4	5	23	0	0.21	16	0.14
3	2	39	0	12	-2	28	1	1	-0.19	8	0.20
4	1	41	2	0	4	17	16	3	-0.14	15	0.12
5	2	41	16	3	15	1	4	0	0.00	7	0.28
2	2	42	-3	-4	-6	10	46	3	0.16	23	-0.14
5	2	42	1	6	15	-2	21	4	0.21	11	0.07
2	2	42	2	14	-4	11	21	0	0.04	8	0.07
4	2	43	2	5	-4	17	22	11	0.03	7	0.16
5	2	43	12	3	13	-3	17	-3	-0.15	18	0.13
5	1	43	13	0	7	1	21	6	0.05	10	0.18
2	2	45	3	3	11	7	19	5	0.03	7	0.14

Table 1, Page 2:

Per-Subject Gains Scores, Experimental Group (read across)

L	S	EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusF	EmbF	Depth
3	1	45	1	0	7	20	16	4	0.00	4	0.20
2	2	48	7	1	12	17	10	-5	1.18	15	0.13
4	2	48	8	4	8	8	17	12	0.15	7	0.21
3	1	50	4	3	-3	25	20	4	-0.02	23	0.14
4	1	50	-4	8	2	16	26	7	-0.26	13	0.21
5	1	50	2	2	7	9	29	7	-0.44	19	0.18
2	1	54	3	-7	11	18	28	6	0.00	8	0.06
4	2	54	-12	11	0	24	31	13	0.06	5	0.15
3	2	55	-8	-1	11	22	32	3	0.15	11	0.16
3	1	55	-7	10	-2	21	34	8	0.18	10	0.21
5	1	56	-1	13	0	10	34	5	0.29	6	0.27
1	1	57	-1	-4	25	8	28	8	0.04	13	0.19
2	2	57	13	4	4	-2	37	-3	0.33	6	0.29
3	1	57	5	-2	-3	10	47	12	-0.35	11	0.09
1	1	58	-4	7	11	26	17	8	0.08	3	0.17
3	2	58	10	0	-17	30	36	18	0.08	17	-0.06
3	1	61	8	3	21	22	5	10	-0.07	14	0.06
5	2	61	14	-2	5	16	26	12	0.05	10	0.32
2	1	62	5	6	2	-2	50	10	0.11	20	-0.20
2	1	62	2	-1	7	23	30	7	-0.04	2	0.27
3	2	62	-3	5	5	26	27	12	0.33	0	0.24
3	1	64	5	5	15	23	14	-3	-0.09	13	0.17
4	2	65	-3	-5	-4	37	41	16	-0.06	18	0.11
4	2	65	1	0	4	33	26	15	-0.13	22	0.26
2	2	72	3	7	14	0	46	13	0.20	18	-0.00
4	1	73	2	11	19	28	0	6	0.33	1	0.22
4	1	74	-6	8	8	30	33	10	0.22	2	0.23
3	2	76	11	6	15	27	15	1	-0.14	13	0.37
4	2	78	-3	1	12	36	32	6	0.02	13	0.40
3	2	80	-4	-2	12	32	72	18	-0.00	17	0.20
2	2	84	11	-4	3	6	67	10	0.10	7	0.13
3	1	84	3	13	8	18	40	8	0.23	14	0.43
3	1	86	6	4	4	25	46	3	0.22	19	0.30
1	1	89	8	5	6	37	31	8	0.17	14	0.28
1	1	92	-7	11	11	26	51	18	0.06	15	0.25
2	2	94	1	7	24	11	50	20	0.22	31	0.13
2	1	94	3	7	12	1	69	5	0.47	14	0.01
4	1	96	23	6	21	18	26	17	0.17	16	0.33
3	2	99	6	7	5	33	46	12	0.13	8	0.40
2	1	106	-2	10	8	46	43	15	0.27	20	0.32
3	1	109	10	0	14	43	42	15	0.42	10	0.34
2	2	119	5	6	37	13	56	11	0.00	22	0.45
1	1	121	0	7	26	34	52	12	0.19	7	0.41
2	1	123	1	5	11	45	59	10	0.25	6	0.50
2	1	127	13	4	22	47	40	13	0.30	13	0.56
2	1	135	-3	7	1	51	78	25	0.18	9	0.26
2	1	135	11	0	-1	46	78	22	0.22	12	0.22
2	2	136	25	11	12	38	48	12	0.05	23	0.46
1	1	167	4	11	25	53	73	7	0.43	21	0.54
1	1	185	-1	14	28	65	77	26	0.23	14	0.62

Table 1, Page 3:

Per-Subject Gains Scores, Control Group (read across)

L	S	EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
5	2	-82	1	-3	-10	-21	-48	-13	0.34	-14	0.28
2	1	-63	-5	0	-13	-18	-25	-7	0.31	-20	-0.12
3	2	-54	3	-18	-8	-13	-16	-8	0.15	-6	-0.03
2	1	-53	-11	-6	5	-35	-5	-15	-0.00	-12	-0.13
5	2	-48	1	-8	-16	5	-30	4	-0.17	-15	-0.22
5	1	-48	-16	0	0	5	-37	-6	0.22	-21	-0.14
5	2	-46	1	-2	-4	-7	-33	0	0.09	-16	-0.04
4	1	-44	-12	-3	-13	-12	-3	1	-0.01	-8	-0.39
4	2	-42	2	-7	5	-15	-26	-18	-0.14	0	-0.04
1	1	-39	1	4	-4	-43	0	-10	-0.17	-14	-0.06
5	1	-38	-3	-7	9	-12	-24	1	0.00	-7	-0.04
4	2	-34	7	-3	-11	-14	-13	-13	0.22	-5	-0.19
5	2	-34	4	1	-1	-13	-25	-8	-0.11	-10	-0.10
5	1	-33	-2	0	-2	-13	-15	-3	0.09	-3	-0.33
2	1	-31	-2	-5	-10	-28	15	-2	-0.11	-1	-0.23
5	1	-31	-0	3	-6	-3	-24	-0	0.02	-11	-0.01
4	2	-30	-2	-6	-17	-8	5	8	-0.00	-8	-0.09
2	2	-28	6	-27	3	2	-13	-10	-0.03	-3	-0.03
4	2	-26	2	1	3	7	-41	-5	-0.12	-7	0.17
4	1	-25	-13	-2	6	-11	-5	5	-0.48	-7	-0.18
1	1	-24	-8	-1	-6	-2	-5	-13	0.03	-8	0.11
4	1	-23	2	-6	-11	7	-15	-3	-0.10	10	-0.20
5	1	-23	6	2	-11	-5	-15	4	-0.75	-8	0.08
3	2	-21	11	-10	-1	-3	-17	1	0.04	-7	0.08
5	2	-21	-3	-5	7	2	-22	0	0.00	-11	-0.18
1	1	-18	-7	-11	-11	16	-5	4	0.03	3	-0.14
2	1	-18	-7	4	-5	-5	-4	0	0.04	-15	0.14
4	1	-18	-11	-1	-1	-4	-1	-3	-0.20	-4	-0.03
4	1	-17	-7	-2	-7	-7	7	0	0.18	-7	-0.01
1	1	-16	-8	-2	5	-1	-10	0	-0.09	-5	-0.01
4	2	-16	-7	-3	7	11	-24	-1	-0.50	0	0.07
5	1	-15	-4	-2	-2	9	-15	-1	0.00	-4	-0.02
4	1	-13	-6	0	-1	-2	-3	-5	0.39	-3	-0.00
4	1	-12	-5	-4	0	10	-3	0	0.00	-11	0.10
2	2	-8	1	1	4	8	-24	-3	-0.32	-2	0.15
5	2	-6	1	-3	-2	-8	6	2	-0.13	-2	-0.14
4	2	-5	-12	-2	-2	10	1	7	-0.20	-8	0.00
3	2	-3	-1	-17	7	21	-13	5	0.06	2	-0.04
5	2	-3	1	1	2	10	-17	3	0.13	2	0.05
4	2	-2	25	-4	1	-11	-13	-2	-0.83	5	0.09
3	2	-1	-2	2	-2	2	-1	0	0.00	3	0.03
4	1	-1	4	-5	-7	-4	12	4	0.00	-7	0.06
1	1	0	1	-6	-3	7	1	2	-0.16	5	-0.09
3	2	0	3	0	1	-5	1	-6	0.56	2	0.12
4	1	1	7	-3	-8	13	-7	-3	0.22	6	-0.09
5	2	1	-0	1	6	-4	-1	-2	-0.09	5	0.06
5	2	1	8	-2	2	-1	-6	0	-0.07	5	0.08
1	1	2	2	-3	18	-4	-11	2	0.10	-7	0.07
5	1	2	5	-1	3	-2	-1	1	0.12	9	-0.00
4	2	3	-1	-2	-3	-21	-6	13	0.20	-3	-0.04

Table 1, Page 4:

Per-Subject Gains Scores, Control Group (read across)

L	S	EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
5	2	4	-0	-0	4	-6	7	11	0.12	-0	-0.02
2	2	5	-4	-4	-4	-12	31	8	-0.20	0	-0.20
5	1	5	-2	5	-2	0	4	4	0.00	3	-0.17
5	1	5	-3	0	5	16	-13	3	0.25	0	0.12
3	1	6	-6	-1	0	23	-8	2	0.03	7	0.00
4	2	6	0	-4	-6	5	12	0	-0.07	-5	0.08
2	2	7	11	3	4	-8	-2	-6	-0.03	3	-0.02
1	1	8	7	-3	16	-10	-2	0	-0.22	13	-0.03
3	2	10	-3	-7	-6	20	7	8	-0.10	-1	0.00
3	2	12	1	3	-3	-4	15	4	0.02	0	-0.03
4	2	12	7	2	1	0	1	2	-0.00	8	0.00
3	2	14	-8	-8	4	12	15	7	-0.25	1	-0.05
3	1	15	-10	0	5	-2	18	2	0.10	3	-0.06
3	1	15	-3	-5	7	6	10	14	0.00	1	-0.06
4	1	15	15	-1	12	-5	-5	-3	-0.45	-5	-0.01
2	2	16	2	-5	18	-2	3	-1	-0.36	3	-0.01
2	2	17	-3	-11	8	7	15	7	0.07	4	0.03
3	2	18	-6	-7	6	2	24	10	0.05	6	-0.17
4	1	21	-1	-2	0	10	14	6	0.10	-13	0.08
3	2	22	-18	-1	0	13	28	8	-0.22	5	-0.15
2	1	23	2	-3	6	2	15	3	-0.09	0	0.01
3	1	24	5	-6	10	1	14	5	-0.22	-6	0.13
3	2	24	-3	-3	-11	15	26	16	0.10	3	-0.03
5	2	25	12	-2	0	13	2	-3	-0.05	7	0.06
1	1	26	-11	-3	-3	20	24	10	0.01	-2	0.17
2	1	26	13	2	11	-3	14	-4	-0.16	5	0.06
3	1	28	-1	-4	2	20	11	1	0.04	13	0.03
2	2	30	-9	-2	5	25	10	7	0.04	0	0.19
5	1	32	-6	7	-4	13	22	11	-0.03	5	0.05
3	1	33	-1	-1	0	35	0	3	0.05	15	0.11
2	2	34	-6	-5	1	23	22	12	-0.14	12	-0.05
2	1	37	3	2	3	11	17	13	-0.30	10	-0.05
2	1	37	2	-5	25	-2	17	11	-0.04	7	0.23
2	1	37	1	-3	21	6	12	6	0.05	2	0.13
3	1	37	7	-8	1	25	12	7	0.00	22	0.09
3	1	41	1	-1	2	10	28	6	-0.36	16	0.13
3	1	41	5	-7	6	16	20	2	0.28	10	0.14
1	1	42	3	4	2	22	9	7	0.04	4	0.14
2	2	42	8	10	-12	17	17	8	0.03	15	0.08
4	2	46	-7	3	4	21	25	10	0.20	13	-0.23
2	2	50	-4	5	-1	35	14	10	0.05	11	0.17
3	1	54	-13	2	-3	30	38	8	0.05	3	0.09
5	1	54	8	1	19	12	12	-2	0.44	16	0.11
2	1	57	4	-3	11	17	27	10	-0.07	8	0.16
3	1	59	-4	-1	11	15	38	6	-0.06	13	0.05
2	2	68	4	0	0	18	45	14	0.11	15	0.18
2	1	72	0	14	16	12	28	4	-0.13	17	0.14
3	2	82	11	5	4	24	36	6	0.12	15	0.34
3	2	90	-2	-4	30	28	38	16	0.16	14	0.10
2	2	196	-11	3	17	75	111	33	0.10	17	0.14

Table 1, Page 5:

Per-Subject Gains Scores, Placebo Group (read across)

L	S	EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
3	1	-72	-8	-5	-14	-27	-15	-5	-0.31	-15	-0.31
3	1	-55	-8	-10	-4	-10	-22	-13	-0.13	-24	-0.06
3	1	-35	-11	-1	-6	-3	-13	-2	-0.07	-18	-0.10
3	1	-21	-6	-12	-2	0	-2	0	-0.04	-1	-0.02
3	1	-13	-10	-1	-4	13	-11	-5	-0.16	-1	0.02
2	1	-11	-6	-4	-10	5	4	2	-0.00	-11	0.01
3	1	-11	12	0	6	-20	-0	-5	-0.08	-7	0.04
3	1	-9	0	-0	-7	-3	2	3	-0.14	-9	0.04
2	1	-8	5	1	-2	0	-13	2	0.09	-6	0.01
3	1	-8	7	2	3	-14	-6	0	0.00	-2	-0.12
3	2	-6	-4	-1	4	-4	-1	1	0.06	-6	-0.13
2	2	-5	-1	7	-4	7	-15	-2	-0.10	0	0.01
2	2	-2	1	-2	-2	4	-3	4	-0.38	11	-0.10
3	2	5	-11	-0	-5	18	4	11	-0.25	-6	0.08
2	1	6	-1	2	-10	-14	33	-3	0.03	7	-0.09
2	1	21	3	0	3	15	-1	4	-0.03	7	0.13
2	1	23	12	4	12	1	-7	1	0.00	-7	0.08
2	2	24	0	8	-1	12	4	5	-0.18	1	-0.02
2	1	28	4	14	3	5	1	16	-0.02	3	0.05
2	1	31	4	-6	1	14	17	-1	0.11	2	0.12
2	2	32	1	8	-7	12	17	5	0.17	6	-0.02
2	2	32	-5	0	13	27	-3	1	0.17	9	0.04
2	2	32	17	2	-6	10	8	6	0.09	10	0.12
3	1	37	-2	-2	1	0	41	11	-0.20	1	-0.02
2	1	37	-1	10	8	8	11	3	0.13	8	0.08
3	2	43	-3	-3	-10	23	36	11	-0.03	2	0.00
3	2	43	-4	-2	17	21	11	10	-0.22	13	0.19
2	2	45	11	-2	2	18	15	13	-0.06	1	0.09
3	1	45	3	-2	-2	31	14	11	-0.27	9	-0.02
2	1	51	4	5	6	14	20	2	0.40	18	0.04
3	2	54	-5	2	0	43	14	7	0.07	13	0.14
3	2	58	0	-13	-8	60	21	12	-0.06	8	0.20
3	1	58	4	4	-3	35	17	6	-0.27	15	0.24
2	1	59	0	20	-0	12	26	-0	0.18	13	0.25
3	2	59	14	3	-10	27	24	6	-0.55	23	0.14
2	2	60	-11	-11	5	18	57	20	-0.14	7	-0.17
2	1	63	8	+12	1	31	9	2	0.25	-8	0.40
2	2	64	-1	-5	13	26	31	12	-0.03	-1	0.30
3	2	64	-3	0	6	35	25	6	-0.05	12	0.07
2	2	66	-3	1	-13	29	52	13	0.06	-1	0.09
3	2	67	-13	-1	10	45	26	18	0.16	3	0.04
3	2	67	4	4	-3	31	31	8	0.16	14	0.24
3	2	68	-8	-2	7	27	44	18	-0.21	13	0.14
2	2	72	3	2	8	31	26	11	0.04	11	0.15
3	2	78	6	-2	7	22	55	21	-0.19	16	0.44
2	1	82	-2	12	29	24	18	7	0.38	16	0.27
2	2	94	6	2	8	22	54	18	-0.05	10	0.22

Table 2, Page 1:

Ranked Gains Scores on Ten Factors, Experimental Group (read down)

EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
-52	-16	-7	-17	-17	-26	-14	-0.44	-25	-0.20
-31	-12	-6	-17	-15	-21	-9	-0.37	-14	-0.14
-28	-9	-6	-16	-15	-16	-7	-0.35	-14	-0.12
-14	-8	-5	-10	-12	-14	-6	-0.28	-10	-0.11
-2	-8	-5	-8	-9	-14	-5	-0.26	-8	-0.11
-1	-7	-4	-8	-7	-10	-4	-0.25	-8	-0.06
1	-7	-4	-7	-6	-7	-4	-0.25	-5	-0.06
1	-7	-4	-6	-4	-6	-3	-0.22	-2	-0.05
4	-6	-2	-6	-3	-4	-3	-0.21	-2	-0.05
7	-6	-2	-6	-3	-3	-3	-0.20	-1	-0.03
10	-4	-2	-6	-2	-1	-3	-0.20	-1	-0.01
11	-4	-2	-4	-2	0	-3	-0.19	-0	-0.01
11	-4	-1	-4	-2	0	-2	-0.15	0	-0.01
11	-4	-1	-4	-2	0	-1	-0.14	0	-0.00
16	-4	-1	-4	-2	0	-1	-0.14	1	0.01
17	-3	-1	-4	-1	1	0	-0.14	1	0.01
23	-3	-0	-3	0	1	0	-0.14	2	0.01
25	-3	-0	-3	1	2	0	-0.14	2	0.02
26	-3	0	-2	1	3	0	-0.13	3	0.04
27	-3	0	-2	1	3	0	-0.13	3	0.04
27	-3	0	-2	2	3	0	-0.13	4	0.05
28	-3	0	-1	2	4	1	-0.09	4	0.06
28	-2	0	0	3	4	1	-0.07	4	0.06
28	-1	0	0	3	5	1	-0.06	4	0.06
29	-1	0	0	3	5	1	-0.06	5	0.07
29	-1	0	0	5	5	1	-0.04	5	0.07
29	0	0	0	5	6	1	-0.03	5	0.07
31	0	1	1	5	9	2	-0.02	6	0.07
31	0	1	1	6	10	2	-0.02	6	0.09
32	1	1	2	6	10	2	-0.02	6	0.09
33	1	1	2	6	11	2	-0.00	6	0.10
33	1	2	2	6	11	2	0.00	7	0.11
34	1	2	2	6	12	3	0.00	7	0.11
35	1	2	2	7	13	3	0.00	7	0.11
35	1	2	3	8	13	3	0.00	7	0.12
36	1	2	3	8	13	3	0.00	7	0.12
37	1	2	3	8	14	4	0.00	7	0.13
37	1	3	4	8	15	4	0.00	7	0.13
38	2	3	4	8	15	4	0.00	7	0.13
38	2	3	4	9	15	4	0.00	7	0.13
39	2	3	4	10	15	4	0.00	7	0.13
41	2	3	4	10	16	4	0.02	8	0.13
41	2	3	4	10	16	5	0.03	8	0.14
42	2	3	5	10	17	5	0.03	8	0.14
42	2	3	5	11	17	5	0.04	8	0.14
42	2	3	5	11	17	5	0.04	8	0.14
43	2	3	5	11	19	5	0.04	8	0.14
43	2	3	5	12	20	5	0.04	8	0.14
43	2	3	5	12	20	6	0.05	8	0.15
45	2	3	5	12	21	6	0.05	9	0.15

Table 2, Page1 continued:

Ranked Gains Scores on Ten Factors, Experimental Group (read down)

EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusF	EmbF	Depth
45	3	3	5	13	21	6	0.05	10	0.16
48	3	4	6	13	21	6	0.05	10	0.16
48	3	4	7	13	22	6	0.06	10	0.17
50	3	4	7	13	22	6	0.06	10	0.17
50	3	4	7	14	23	6	0.06	11	0.17
50	3	4	7	16	25	7	0.07	11	0.17
54	3	4	7	16	26	7	0.08	11	0.17
54	3	4	7	17	26	7	0.08	11	0.18
55	3	4	8	17	26	7	0.09	12	0.18
55	3	4	8	17	26	7	0.09	12	0.18
56	3	5	8	18	27	8	0.10	12	0.19
57	4	5	8	18	28	8	0.10	12	0.19
57	4	5	8	18	28	8	0.11	12	0.20
57	4	5	8	20	29	8	0.11	13	0.20
58	5	5	8	21	30	8	0.13	13	0.20
58	5	5	10	22	31	8	0.13	13	0.20
61	5	5	11	22	31	8	0.13	13	0.21
61	5	5	11	23	32	10	0.14	13	0.21
62	5	5	11	23	32	10	0.15	13	0.21
62	5	6	11	23	32	10	0.15	14	0.22
62	6	6	11	24	32	10	0.16	14	0.22
64	6	6	11	25	33	10	0.16	14	0.23
65	6	6	11	25	34	10	0.17	14	0.24
65	7	6	11	25	34	11	0.17	14	0.25
72	7	6	12	26	36	11	0.18	14	0.26
73	8	7	12	26	37	11	0.18	15	0.26
74	8	7	12	26	40	11	0.19	15	0.26
76	8	7	12	27	40	12	0.19	15	0.27
78	10	7	12	28	41	12	0.20	15	0.27
80	10	7	12	28	42	12	0.20	15	0.27
84	10	7	12	30	42	12	0.21	16	0.28
84	10	7	13	30	43	12	0.21	16	0.28
86	11	7	14	30	46	12	0.22	17	0.29
89	11	8	14	32	46	12	0.22	17	0.30
92	11	8	15	33	46	13	0.22	17	0.32
94	11	8	15	33	46	13	0.22	17	0.32
94	11	8	15	34	47	13	0.23	18	0.32
96	12	10	15	35	48	15	0.23	18	0.33
99	12	10	16	36	50	15	0.25	18	0.34
106	12	11	16	37	50	15	0.27	19	0.37
109	12	11	19	37	51	16	0.29	19	0.40
119	13	11	21	38	52	17	0.30	20	0.40
121	13	11	21	43	56	17	0.30	20	0.41
123	13	11	22	45	59	18	0.33	21	0.43
127	14	11	24	46	67	18	0.33	22	0.45
135	14	12	25	46	69	18	0.33	22	0.46
135	16	13	25	47	73	20	0.42	23	0.50
136	20	13	26	51	77	22	0.43	23	0.54
167	23	14	28	53	78	25	0.47	23	0.56
185	25	14	37	65	78	26	1.18	31	0.62

Table 2, Page 2:

Ranked Gains Scores on Ten Factors, Control Group (read down)

EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
-82	-18	-18	-17	-43	-48	-18	-0.83	-21	-0.39
-63	-16	-17	-16	-35	-41	-15	-0.75	-20	-0.33
-54	-13	-11	-13	-28	-37	-13	-0.50	-16	-0.28
-53	-13	-11	-13	-21	-33	-13	-0.48	-15	-0.23
-48	-12	-10	-12	-18	-30	-13	-0.45	-15	-0.23
-48	-12	-27	-11	-15	-26	-10	-0.36	-14	-0.22
-46	-11	-8	-11	-14	-25	-10	-0.36	-14	-0.20
-44	-11	-8	-11	-13	-25	-8	-0.32	-13	-0.20
-42	-11	-8	-11	-13	-24	-8	-0.30	-12	-0.19
-39	-11	-7	-11	-13	-24	-7	-0.25	-11	-0.18
-38	-10	-7	-10	-12	-24	-6	-0.22	-11	-0.18
-34	-8	-7	-10	-12	-24	-6	-0.22	-11	-0.17
-34	-8	-7	-8	-12	-22	-6	-0.22	-10	-0.17
-33	-8	-7	-8	-11	-17	-5	-0.20	-8	-0.15
-31	-8	-6	-7	-11	-17	-5	-0.20	-8	-0.14
-31	-7	-6	-7	-10	-16	-4	-0.20	-8	-0.14
-30	-7	-6	-6	-8	-15	-3	-0.17	-8	-0.14
-28	-7	-6	-6	-8	-15	-3	-0.17	-8	-0.13
-26	-7	-6	-6	-8	-15	-3	-0.16	-7	-0.12
-25	-7	-5	-6	-7	-15	-3	-0.16	-7	-0.10
-24	-6	-5	-5	-7	-13	-3	-0.14	-7	-0.09
-23	-6	-5	-4	-6	-13	-3	-0.14	-7	-0.09
-23	-6	-5	-4	-5	-13	-3	-0.13	-7	-0.09
-21	-6	-5	-4	-5	-13	-2	-0.13	-7	-0.06
-21	-6	-5	-4	-5	-13	-2	-0.12	-7	-0.06
-18	-5	-5	-3	-5	-12	-2	-0.11	-6	-0.06
-18	-5	-4	-3	-4	-11	-2	-0.11	-6	-0.05
-18	-4	-4	-3	-4	-10	-1	-0.10	-5	-0.05
-17	-4	-4	-3	-4	-8	-1	-0.10	-5	-0.05
-16	-4	-4	-3	-4	-7	-1	-0.09	-5	-0.04
-16	-4	-4	-2	-4	-6	-0	-0.09	-5	-0.04
-15	-3	-4	-2	-3	-6	0	-0.09	-4	-0.04
-13	-3	-3	-2	-3	-5	0	-0.07	-4	-0.04
-12	-3	-3	-2	-3	-5	0	-0.07	-3	-0.04
-8	-3	-3	-2	-2	-5	0	-0.07	-3	-0.03
-6	-3	-3	-2	-2	-5	0	-0.06	-3	-0.03
-5	-3	-3	-1	-2	-5	0	-0.05	-3	-0.03
-3	-3	-3	-1	-2	-4	0	-0.04	-2	-0.03
-3	-2	-3	-1	-2	-3	0	-0.03	-2	-0.03
-2	-2	-3	-1	-2	-3	0	-0.03	-2	-0.03
-1	-2	-3	-1	-1	-2	0	-0.03	-1	-0.02
-1	-2	-3	0	-1	-2	1	-0.01	-1	-0.02
0	-2	-3	0	0	-1	1	-0.00	-0	-0.02
0	-2	-3	0	0	-1	1	-0.00	0	-0.01
1	-1	-3	0	1	-1	1	-0.00	0	-0.01
1	-1	-2	0	2	-1	1	0.	0	-0.01
1	-1	-2	0	2	0	2	0.	0	-0.01
2	-1	-2	0	2	0	2	0.	0	-0.01
2	-1	-2	0	2	1	2	0.	0	-0.00
3	-0	-2	1	2	1	2	0.	0	-0.00

Table 2, Page 2 continued:

Ranked Gains Scores on Ten Factors, Control Group (read down)

EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
4	-0	-2	1	5	1	2	0.00	1	0.00
5	-0	-2	1	5	1	2	0.00	1	0.00
5	0	-2	1	5	2	2	0.00	2	0.00
5	0	-2	1	6	3	3	0.00	2	0.00
6	1	-2	2	6	4	3	0.01	2	0.01
6	1	-2	2	7	5	3	0.02	2	0.03
7	1	-1	2	7	6	3	0.02	3	0.03
8	1	-1	2	7	7	4	0.03	3	0.03
10	1	-1	2	7	7	4	0.03	3	0.05
12	1	-1	3	8	7	4	0.03	3	0.05
12	1	-1	3	9	9	4	0.03	3	0.05
14	1	-1	3	10	10	4	0.04	3	0.06
15	1	-1	3	10	10	4	0.04	3	0.06
15	1	-1	4	10	11	4	0.04	3	0.06
15	1	-1	4	10	12	5	0.14	4	0.06
16	2	-0	4	10	12	5	0.04	4	0.07
17	2	0	4	11	12	5	0.05	5	0.07
18	2	0	4	11	12	6	0.05	5	0.08
21	2	0	4	12	12	6	0.05	5	0.08
22	2	0	5	12	14	6	0.05	5	0.08
23	2	0	5	12	14	6	0.05	5	0.08
24	2	0	5	13	14	6	0.06	5	0.08
24	3	0	5	13	14	7	0.07	5	0.08
25	3	0	5	13	15	7	0.09	6	0.09
26	3	1	5	13	15	7	0.09	6	0.09
26	3	1	6	15	15	7	0.10	7	0.09
28	4	1	6	15	15	7	0.10	7	0.10
30	4	1	6	16	15	7	0.10	7	0.10
32	4	1	6	16	17	8	0.10	8	0.11
33	4	1	6	16	17	8	0.10	8	0.11
34	5	2	7	16	17	8	0.11	9	0.11
37	5	2	7	17	18	8	0.12	10	0.12
37	5	2	7	17	20	8	0.12	10	0.12
37	6	2	7	18	22	8	0.12	11	0.13
37	6	2	8	20	22	10	0.13	12	0.13
41	7	2	9	20	24	10	0.15	13	0.13
41	7	3	10	20	24	10	0.16	13	0.14
42	7	3	11	21	25	10	0.18	13	0.14
42	7	3	11	21	26	10	0.20	13	0.14
46	7	3	11	22	27	11	0.20	14	0.14
50	8	3	12	23	28	11	0.22	15	0.14
54	8	4	16	23	28	11	0.22	15	0.15
54	8	4	16	24	28	12	0.22	15	0.16
57	11	4	17	25	31	13	0.25	15	0.17
59	11	5	18	25	36	13	0.28	16	0.17
68	11	5	18	28	38	14	0.31	16	0.17
72	12	5	19	30	38	14	0.34	17	0.18
82	13	7	21	35	38	16	0.39	17	0.19
90	15	10	25	35	45	16	0.44	17	0.23
196	25	14	30	75	111	33	0.56	22	0.34

Table 2, Page 3:

Ranked Gains Scores on Ten Factors, Placebo Group (read down)

EKS	NCls	NPhs	RCls	RPhs	RWds	CluF	ClusS	EmbF	Depth
-72	-13	-13	-14	-27	-22	-13	-0.55	-24	-0.31
-55	-11	-12	-13	-20	-15	-5	-0.38	-18	-0.17
-35	-11	-11	-10	-14	-15	-5	-0.31	-15	-0.13
-21	-11	-10	-10	-14	-13	-5	-0.27	-11	-0.12
-13	-10	-6	-10	-10	-13	-3	-0.27	-9	-0.10
-11	-8	-5	-10	-4	-11	-2	-0.25	-8	-0.10
-11	-8	-5	-8	-3	-9	-2	-0.22	-7	-0.09
-9	-8	-4	-7	-3	-7	-1	-0.21	-7	-0.06
-8	-6	-3	-7	0	-6	-0	-0.20	-6	-0.02
-8	-6	-2	-6	0	-3	0	-0.19	-6	-0.02
-6	-5	-2	-6	0	-3	0	-0.18	-6	-0.02
-5	-5	-2	-5	1	-2	1	-0.16	-2	-0.02
-2	-4	-2	-4	4	-1	1	-0.14	-1	-0.02
5	-4	-2	-4	5	-1	1	-0.14	-1	0.00
6	-3	-2	-4	5	1	2	-0.13	-1	0.01
21	-3	-2	-3	7	2	2	-0.10	-1	0.01
23	-3	-1	-3	8	4	2	-0.08	0	0.01
24	-2	-1	-2	10	4	2	-0.07	1	0.02
28	-2	-1	-2	12	4	3	-0.06	1	0.04
31	-1	-1	-2	12	8	3	-0.06	1	0.04
32	-1	-0	-2	12	9	4	-0.05	2	0.04
32	-1	-0	-1	13	11	4	-0.05	2	0.04
32	-1	0	-0	14	11	5	-0.04	3	0.04
37	-0	0	0	14	14	5	-0.03	3	0.05
37	0	0	1	15	14	6	-0.03	6	0.07
43	0	0	1	18	15	6	-0.03	7	0.08
43	0	1	1	18	17	6	-0.02	7	0.08
45	1	1	2	18	17	6	-0.00	7	0.08
45	1	2	3	21	17	7	0.	8	0.09
51	3	2	3	22	18	7	0.00	8	0.09
54	3	2	3	22	20	8	0.03	9	0.12
58	3	2	4	23	21	10	0.04	9	0.12
58	4	2	5	24	24	11	0.06	10	0.13
59	4	2	6	26	25	11	0.06	10	0.14
59	4	3	6	27	26	11	0.07	11	0.14
60	4	4	6	27	26	11	0.09	11	0.14
63	4	4	7	27	26	11	0.09	12	0.15
64	5	4	7	29	31	12	0.11	13	0.19
64	6	5	8	31	31	12	0.13	13	0.20
66	6	7	8	31	33	13	0.16	13	0.22
67	7	8	8	31	36	13	0.16	13	0.24
67	8	8	10	31	41	16	0.17	14	0.24
68	11	10	12	35	44	18	0.17	15	0.25
72	12	12	13	35	52	18	0.18	16	0.27
78	12	12	13	43	54	18	0.25	16	0.30
82	14	14	17	45	55	20	0.38	18	0.40
94	17	20	29	60	57	21	0.40	23	0.44

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